The Petroleum Engineer

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• Drilling and Producing • Refining and Gas Processing • Oil and Gas Pipelining

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GENERAL

Treasure in the Depths A-33
Ernestine Adams
Kuwait Oil Progress A-46
V. S. Swaminathan
Better V-Belt Drives for Less Money E-2
F. J. Donahue

Features

Course of Oil A-4
Scanning Washington's Oil Horizon A-8
Highlights in Oildom A-10
National Petroleum Situation A-12
Petrolic Personalities A-14
Meetings A-18
Letters to the Editors A-22
Petroleum Profile A-52
Ralph B. McLaughlin
General News E-3
General Personals E-12
The Petroleum Engineer's Continuous Tables E-15
(Installment No. 161—Bibliography)
Laugh With Barney E-22
Oil and Gas Trade News E-26
Trade Personals E-30
Machinery and Equipment E-37
Trade Literature E-44
Books You May Want E-46

DRILLING AND PRODUCING

Deep Pennsylvanian Reef Discoveries Spur Exploration B-7
K. Marshall Fagin
Anti-Earthquake Damage Operations B-11
D. L. Roberts
For Offshore or Isolated Wells—Automatic Surface Safety Valve B-16
C. A. Kizer
"On the Beam" Pumping B-27
J. S. Fuller
The Bassinger Rotary Percussion Drill B-42
Robinson Brown
Oil Country Tubular Goods B-54
Henry J. Wallace
Lubricated Plug Valves for Drilling and Wellhead Services B-59
E. E. Hedene

Features

Editorial B-3
Deep Drilling in West Texas
News B-70
Drilling B-74
Exploration Activities B-78
Running Tour With Men in the Industry B-82

REFINING AND GAS PROCESSING

Selection of Electric Motors C-7
Joe Benish
The Technical Forum—Specific Heat Ratio in Compression Calculations C-13
Wayne C. Edmister
Material and Heat Balance Calculations C-20
G. L. Farrar
Deep Rock Builds Today for Tomorrow C-29
W. T. Ziegenhain
New Knockless Engine C-34
Arch L. Foster
Insulation—Banded-Block Technique C-40
Richard L. Davis
Performance Evaluation Keynotes SAE Meet C-42
Arch L. Foster

Features

The Turnaround C-3
News C-44
Personals C-48

OIL AND GAS PIPELINING

Blowout Safety Device D-5
Frank H. Love
Crude Oil and Refined Products Pipe Line Mileage in the United States January 1, 1950 ..... D-9
A. T. Coumbe and I. F. Avery
Pumps for Army Pipe Lines D-13
Crankcase Explosions D-15
F. V. Cook
Remotely Controlled Stations D-19
S. S. Smith
Natural Gas Dehydration Units Completely Robotized D-26
C. B. Ames
Sweat Fell on Alabama D-29
Developments in Coatings and Cathodic Protection D-35
Carlton L. Goodwin
Second Longest Microwave System D-38

Features

The Firing Line—Service Pipe Line's New Building D-3
Pictorial D-32
News D-39
Pipe Line Personals D-42
Pipe Line Projects D-44
With the Pipe Line Contractors D-48

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the Course of OIL

"LET'S DRILL IT DEEPER"

You know the scene. You may have been there yourself. Several of the crew are standing around and the boss looks as if his last cent is gone (as it may be). They have drilled as deep as they expected to go and no gas or oil has been found.

"Let's drill a few feet more," says the driller, or the toolpusher, or an optimistic geologist, and the boss agrees.

So they go down another hundred feet (or two feet, according to some of the tales) and a rumble comes from deep in the earth. Men leave their tools and flee. Gas and oil, like imprisoned claustrophobiac twins, spring released toward the great open sky. (More recently, the production simply rushes through a turn in the pipes.)

This is one of the recurring legends of the oil industry and, like many apocryphal accounts, it has a strong basis in actual events. Since the drilling of the Drake well the bit has been sinking ever deeper into the earth, and as it went deeper it unlocked new reservoirs of oil and gas.

The early types of bits gave way to new rock bits and diamond bits, which manufacturers made up to match the operators' desire to drill deeper. Casings were made stouter; rigs were built bigger, and electronics crept in to help control the greater power and accomplish such errands as giving the bit a chance to work on its feet. Mud chemists contributed their know-how and staved off the pressures that surged in the depths.

This is a gigantic, colossal, uniquely American story—this story of an industry that spent $300,000,000 to see what it could find from two to four miles straight down in the earth, with no subsidies from government, no cost to consumers. In fact, the industry's daring paid off. It is making money from a segment of earth that no one else can reach.

"Let's drill it deeper," says the driller, or the boss, or the roughneck, and they can say it and do it. They have the decision and they have the tools. It is no wonder that a free oil and almost free gas industry runs circles around the government monopolies of totalitarian countries. Can you imagine the thousands of feet of red tape that would get you a thousand feet of pipe to drill deeper than a totalitarian oil bureau said to drill?

In the U. S. there were 832 holes below 12,000 ft on January 1, 1950 and they had discovered 207 new oil and gas pools. In all other countries 20 of these deep wells had been drilled and one found oil.

If there are oil or gas reservoirs three or four miles under us, the industry will find it—come hell or deep water . . . provided the industry is left free to make its own decisions.—E.A.

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Chrysler Industrial 12—one of eight basic models

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Scanning WASHINGTON'S OIL HORIZON

WASHINGTON—For the first time in their booby-trapped career, PAD officials are relaxing from the strain of fighting off Interior Department planners—who would have liked to subject PAD to some sort of top-side "coordinating" supervision—and the gas transmission and utility industry, many of whose members wanted a separate "Gas Administration for Defense" under Secretary Chapman.

Now, both questions have been answered—completely satisfactorily to PAD Deputy Bruce K. Brown (Pan-Am Southern) and his associates. In his speech at the API, Chapman stressed that PAD would be the "only" petroleum administration, within the purview of his defense authority. And, when Chapman got back to Washington, he lost no time in instructing his staff advisers—who had been pushing an over-all "minerals and energy administration," that regardless of how coal, power, and minerals were coordinated, or supervised, PAD was to be "cut loose" from any such hamstringing.

The gas issue was settled, indirectly, in the agreement on control of materials reached, and signed, between PAD and the National Production Authority, headed by W. H. Harrison. This agreement provides that PAD "will serve as claimant agency before the National Production Authority as to all phases of the domestic petroleum and gas industries . . ." This broad language, covering "all phases" of both industries means there is now very little possibility of gas divorcing itself from its big brother, Oil, in Interior's defense set-up.

▸ **PAD Concept Changes.** Now, the whole concept of the PAD has changed. At first, a large organization, with several hundred employes, split up into numerous operating divisions, was envisaged, with an appropriation of $500,000 for the balance of 1950. But, since Deputy PAD Brown stepped in to set up the PAD—at first, informally, prior to his appointment—this idea has been drastically revamped. Now, the decision is to have only a small, select staff of top oil men, with necessary clerical help, to man a three-pronged organization, with assistant deputies on Materials, Programming, and Foreign activities, each of whom will have under him specialists on refining, production, and supply and distribution. As a concession to the gas industry, an assistant deputy on gas would be appointed, and the National Petroleum Council expanded to take in more men from the gas industry.

▸ **Materials Main Job.** In recent weeks it has become apparent to PAD that biggest job facing it is obtaining sufficient steel, and other critical materials, to maintain essential oil and gas operations, particularly in the production branch, to meet upcoming increases in demand. Making the job tougher, NPA has been setting up specialized materials deals on freight cars, ore boats, and others in prospect that threaten to siphon off materials before a program could be set up to take care of oil and gas.

Also, the attitude that detailed supervision of production, refining, distribution, and transportation activities of the industry was necessary, disappeared. There are now no oil shortages, none in prospect, barring huge and sudden increases in military requirements. Crude production is ample, transportation and refining capacity is adequate, except for additional special equipment that is needed. And imports are expected to increase, while fuel oil stocks, once viewed as a trouble spot, have improved to the point where no one seriously expects any difficulties during the coming winter.

▸ **Avgas.** Aside from the growing seriousness of materials pinch, only major oil supply problem seems to be high grade aviation gasoline for the military. Even here, however, PAD is confident requirements can be adequately met, despite inevitable increases next year. So far the voluntary swapping program of components among refiners, directed by PAD, has pretty well closed the gap. But, to insure against future trouble, it would not be surprising if PAD devalued civilian mogas, lopping off one or two octanes, in order to save TEL and components, for stockpiling against future demands.

▸ **Congress.** A more conservative Congress, dominated by a Republican-Southern Democrat coalition takes over in January, but aside from the generally more favorable attitude towards all business, including oil, the situation is little changed on Capitol Hill. Perhaps the most significant aspect concerns the future of Senator O'Mahoney (D., Wyoming), who seems to be developing into the most likely candidate as Majority Leader—to replace Senator Lucas (D., Illinois)—who may have his arm twisted to take this thankless job. If he does, the next chairman of the Senate Interior Committee probably will be Senator Murray (D., Montana), who has gone down the line for the New and Fair Deals, and won't hesitate to take a crack at oil, or the other minerals industries.

There has been no indication what line the Administration will take next in its attack on the oil and gas percentage depletion allowance, but most observers feel another one is coming—probably in the tax hearings starting next year. The House Ways and Means Committee membership will stack up the same, but there is a possibility of action there.

In the Senate, however, another staunch supporter of the allowance will be added—Rep. Mike Monroney (D., Oklahoma). Although a "Fair Dealer," Monroney has often parted ways with the White House, as a member of the House. Along with Senators George (D., Georgia) and Millikin (R., Colorado), Monroney may prove an insuperable obstacle to any action on percentage depletion by the Treasury Department.

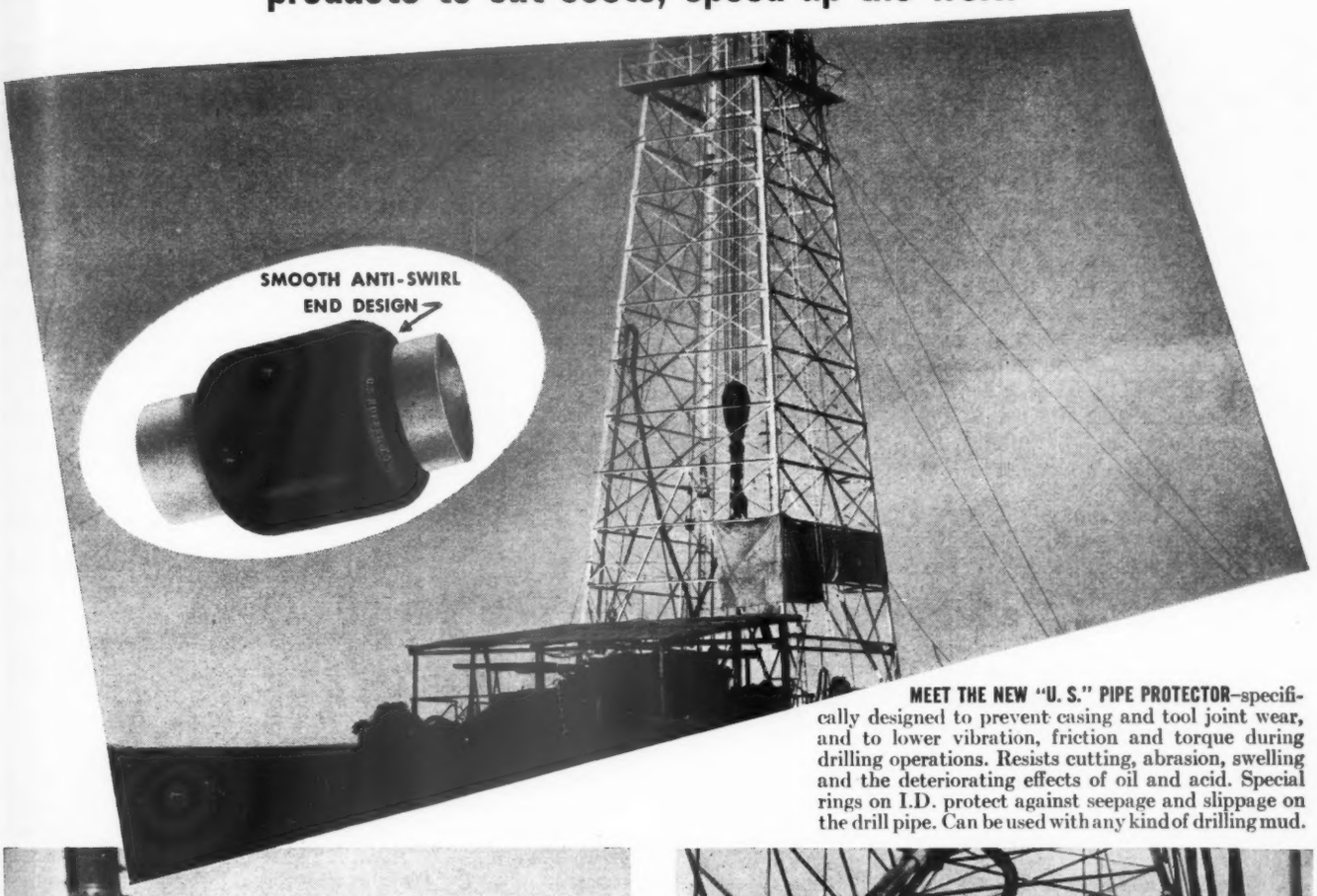
One of the $64 questions in the new session will be: Can Senators Lyndon Johnson (D., Texas) and Kerr (D., Oklahoma) successfully get another bill exempting independent gas producers and gatherers past the White House? If they try again, it is almost certain they will work closely with the downtown departments, particularly FPC and Interior —and the White House—to guarantee an OK, if a bill passes Congress.

▸ **Tidelands.** Senator Murray's attitude on tidelands is interesting in view of the possibility he may succeed O'Mahoney on the important Senate Interior Committee. He is sympathetic towards claims of the offshore California tidelands applicants—who started all the shouting on that issue years ago. He may insist on a provision in any tidelands bill, to protect the "rights" of these applicants.

But, this issue, legislative-wise is getting more complicated every day. Now, Secretary Chapman is convinced that —lacking interim operating legislation—all he can do for offshore Louisiana operators is to continue their state leases for a short period—perhaps only a few weeks—while they negotiate "contracts" with him, for continued production, on a "cost" plus basis. (Chapman's strategy may be to make an interim law—like the O'Mahoney bill—look so good that the industry, generally, will get behind it during the lame-duck session, which ends before Christmas.)

SAVING MORE DRILLING DOLLARS

Operators throughout the oil fields depend on U. S. Rubber products to cut costs, speed up the work



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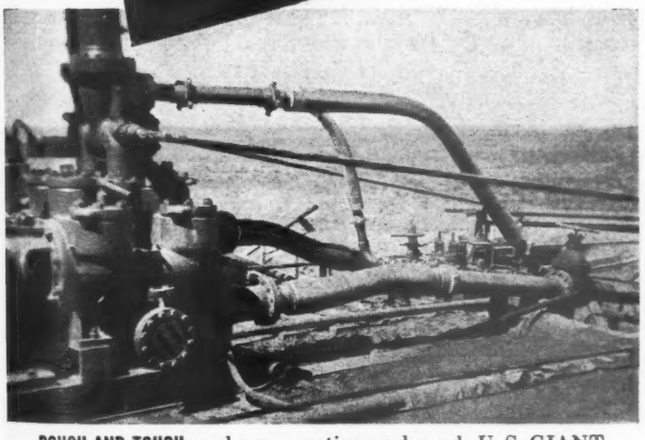

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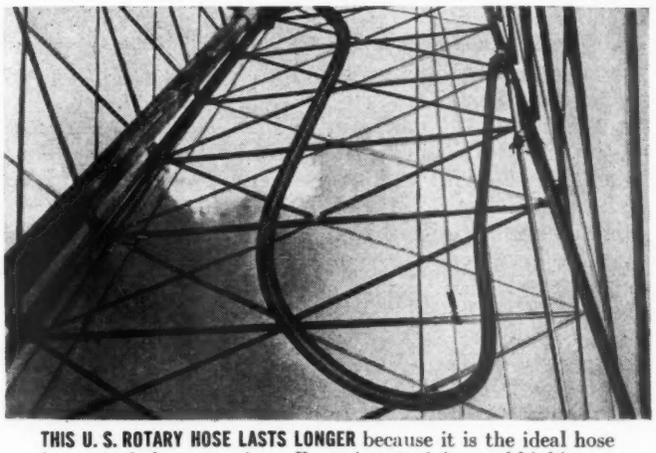

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HIGHLIGHTS IN OILDOM

▸ **Chapman Warns of Steel Shortage.** Secretary of the Interior **Oscar L. Chapman** told the American Petroleum Institute at its 30th annual convention, that shortages of specialized steel products "appear to be reaching alarming proportions," and that governmental allocating may be necessary to meet the problem. "There is a growing shortage in the supply of materials, equipment, and facilities required by the oil and gas industries. We will do our best to obtain these supplies. Unless they are forthcoming, the government may be forced to regulate the use of steel or other critical materials in oil and gas operations," Chapman said.

▸ **Calls for Better Understanding.** In an address spotlighting the key role that must be played by the oil industry at this crucial time, **Frank M. Porter,** president of API, deplored the lack of understanding and unsympathetic attitudes being demonstrated in some sections of the government. At a general session during the API's 30th annual meeting, Porter declared that "petroleum is one of the most important factors in the final determination of whether this and other governments of free people will survive, or whether the totalitarian philosophy of communism will prevail." He continued: "If the petroleum industry is to fulfill its responsibilities in repelling the growing threats to our national security . . . it is essential that conditions must prevail that will assure the industry a reasonable opportunity to continue finding adequate supplies of petroleum for such purposes, in order of their paramount necessity."

▸ **Dollar-Sterling Problem.** The American oil industry has virtually solved its share of the difficult, worldwide dollar-sterling problem and appears well on the way toward successful adjustment of the remaining aspects. So declared **H. D. Armstrong,** assistant to the chairman of the board, Standard Oil Company of California, at the Financial and Accounting sessions of the API in Los Angeles. He warned that the problem might be recurrent because of the general shortage of dollars on the part of many foreign countries. But, based on past performance, "we can expect our industry to meet these difficulties successfully," he said.

▸ **Hamon Speaks for Independent Producer.** President of Mid-Continent Oil and Gas Association, **Jake L. Hamon** called upon the federal government for assurance that the odds will not be "tilted against" independent natural gas producers through destructive legislation. Speaking at a general session during the 30th annual meeting of the API, Hamon pointed to the Harris-Kerr bill as an example, saying: "There our position was very logical; namely, that we didn't want a Federal Bureau to have jurisdiction over the production of gas at the well." Congress agreed with the producers and passed the bill, even after propaganda "of the most vicious sort" had been employed against the proponents. Hamon blamed pressure by ill-informed and "radical groups" for the presidential veto of the bill.

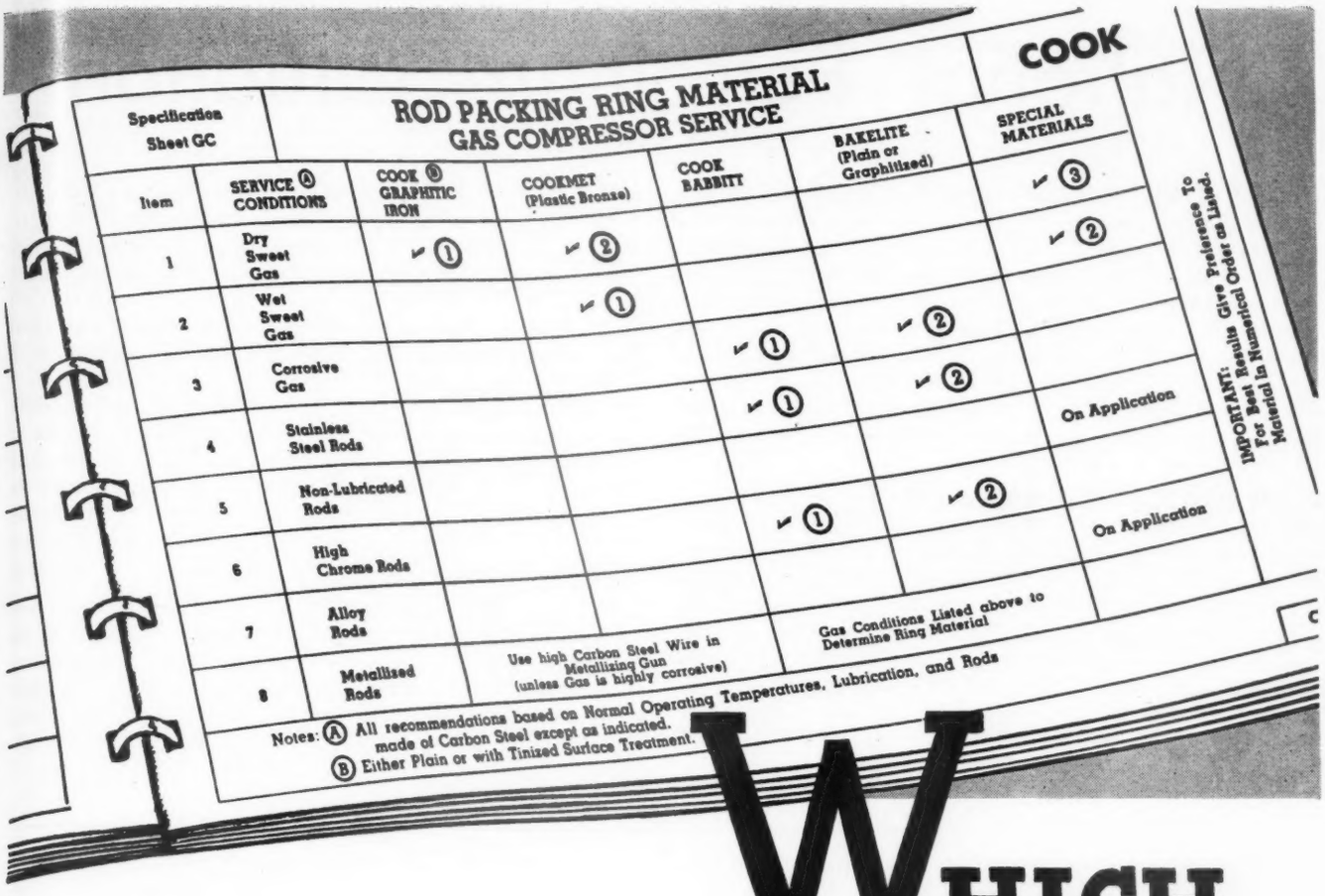
▸ **Enough Steel for 1951: Fairless.** America's oil industry will probably have the steel it needs for field operations during the rest of this year and 1951, provided it doesn't try to stockpile. Requirements for pipe lines and marketing facilities, however, will have to be "re-examined." Benjamin F. Fairless, president of United States Steel Corporation, drew this picture for the nation's oil industry leaders at the 30th annual meeting of the API. Warning of a prospective price boost, he declared that "if the cost of making steel should rise 10 per cent, for example, it would be inevitable, I think, that the price of steel should do likewise."

▸ **Sees End of Petroleum Price Tie-in.** Completion of the large new pipe lines from the Persian Gulf oil fields to the Mediterranean, and the conclusion of Europe's refinery construction program will mean the end of the present tie-in between Middle East and United States oil prices. This is predicted by **Walter J. Levy,** former ECA petroleum director, who is currently a petroleum consultant to the National Security Resources Board and other U. S. agencies and private companies in a story published by the New York Journal of Commerce. Levy foresees a Mediterranean terminal price range that would allow Middle East crude oils to compete in eastern U. S. markets. The Middle East crudes would range between $1.91 and $2.72 per barrel.

▸ **Western Oil Investments Boom.** Oil industry investments in the five Pacific Coast states necessary to provide 90 per cent of all the energy consumed in the territory have boomed over the four billion dollar mark for the first time in history, it was revealed by **Reese H. Taylor,** president of the Western Oil and Gas Association. "In California alone," Taylor said, "oil companies have invested more than $1,200,000,000 in capital assets since 1946." The particular importance of oil on the west coast is apparent, Taylor said, with the realization that hydro-electric power, coal, and all other forms of energy combined create only 10 per cent of the power used in five states.

▸ **Conservation of Oil Reserves Urged.** Further conservation of America's oil reserves by controlled production and unitized operation of oil fields wherever the latter is practicable was called for at a group session of the Division of Production, API, in Los Angeles. The speaker, **George W. Hazlett,** of Cleveland, Ohio, declared that, contrary to opinions held in some oil-producing states that still have no conservation law, "the restraints imposed by conservation practices are in harmony with common-law principles which long antedate commercial production of oil and gas." The restraints referred to by Hazlett are those affecting the land owner to the extent that he is prevented, under the usual conservation law, from withdrawing more than his fair share of oil from the field or "pool" on which his land is situated.

▸ **Oil Shale Reserves.** Tremendous reserves of coal and oil shale in America stand as a promising backstop against increasing demands on the nation's petroleum reserves. Conversion of these abundant raw materials into synthetic fuels to supplement oil is on the threshold of blossoming into a new industry. These were highlights in a message from **James Boyd,** director, U.S. Bureau of Mines, to a marketing and refining group session at the 30th annual meeting of the API. Dr. W. C. Schroeder, chief of the Bureau of Mines' synthetic liquid fuels branch, read Boyd's prepared paper. Pointing up the heavy current demand for oil, the message indicated consumption is expected to reach 2,432 million barrels this year.



Specification Sheet GC

ROD PACKING RING MATERIAL
GAS COMPRESSOR SERVICE

COOK

Item	SERVICE (A) CONDITIONS	COOK (B) GRAPHITIC IRON	COOKMET (Plastic Bronze)	COOK BABBITT	BAKELITE (Plain or Graphitized)	SPECIAL MATERIALS
1	Dry Sweet Gas	✓ (1)	✓ (2)			✓ (3)
2	Wet Sweet Gas		✓ (1)			✓ (2)
3	Corrosive Gas			✓ (1)	✓ (2)	
4	Stainless Steel Rods			✓ (1)	✓ (2)	On Application
5	Non-Lubricated Rods					
6	High Chrome Rods			✓ (1)	✓ (2)	On Application
7	Alloy Rods					
8	Metallized Rods	Use high Carbon Steel Wire in Metallizing Gun (unless Gas is highly corrosive)		Gas Conditions Listed above to Determine Ring Material		

IMPORTANT: For Best Results Give Preference To Material In Numerical Order as Listed.

Notes: (A) All recommendations based on Normal Operating Temperatures, Lubrication, and Rods made of Carbon Steel except as indicated.
(B) Either Plain or with Tinized Surface Treatment.

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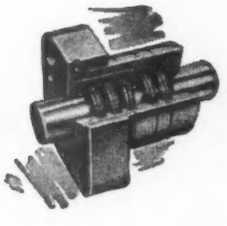
ROD PACKINGS



. . . . SEALING PRESSURES SINCE 1888 . . . .

National Petroleum Situation

By H. J. STRUTH*

STOCK SITUATION IMPROVING. Continued high rate of crude oil production and refinery operations has effected material improvement in the oil industry's stock position. Stocks of all oils at the close of October are believed to have increased to a total of 600,195,000 bbl, which indicated an increase during October of nearly 20,000,000 bbl. Total stocks are now only four per cent below a year ago. Crude oil stocks are only two per cent below last year, while stocks of motor fuel are six per cent greater. Fuel oil stocks were increased in October by about 11,000,000 bbl, but are still 18 per cent below a year ago.

HIGH PRODUCTION RATE. National crude oil production averaged about 5,945,000 bbl daily in October, which was slightly below the September level. Current production is more than 900,000 bbl daily above the rate reported a year ago. Texas crude production is 650,000 bbl a day greater than a year ago. Other increases for the same comparable period are Oklahoma 81,000; Louisiana 65,000; California 52,000; Wyoming 45,000, and Kansas 36,000. The demand for crude oil in the United States has shown an increase over a year ago of about 779,000 bbl daily.

*Petroleum Economist.

HIGHER IMPORTS. According to preliminary data currently being obtained by the American Petroleum Institute, imports of both crude oil and refined products are increasing. The figures indicate that imports of crude oil amounted to about 16,600,000 bbl in October, against 15,500,000 bbl in September. Imports of refined products, largely residual fuel oils, increased from 8,800,000 bbl in September to 9,300,000 bbl in October. Significant in this connection is the realization that residual fuel oil supplies are seriously short of current and projected requirements. Production of residuals is currently only 154,000 bbl daily greater than last year, while demand is 246,000 bbl a day greater than last year. Higher imports of residuals and heavy crude oils are definitely necessary to cushion the deficiency in domestic supplies, and prevent further inroads into low inventories.

DRILLING RATE HIGH. Drilling operations are 11 per cent greater than last year. Development drilling has increased 11 per cent, while wildcat completions have shown an increase of 16 per cent. Well completions in the first ten months of this year totaled 35,410, against 32,017 last year. Wildcat completions totaled 6566, against 5655 last year. Material increases have been recorded in all states except California and Mississippi.

Comparative Statistics, October, 1950

*All figures are computed on a Bureau of Mines' Basis**

	Oct. 1950Ⓟ	Sept. 1950Ⓡ	Oct. 1949	This Year to dateⓅ	Last Year to date	Per cent change
Total supply, all oils	224,817	217,667	194,318	2,015,280	1,844,168	+ 9
Daily average	7,252	7,256	6,268	6,629	6,066	
Total demand, all oils	205,082	201,477	186,350	2,013,249	1,823,143	+10
Daily average	6,616	6,716	6,011	6,623	5,997	
Change in stocks	+19,735	+16,190	+ 7,968	+2,031	+21,025	—
Crude supply	200,900	194,300	171,273	1,771,444	1,656,236	+ 7
Daily average	6,481	6,477	5,525	5,827	5,448	
Crude demand	197,250	190,650	172,030	1,780,780	1,661,931	+ 7
Daily average	6,363	6,355	5,549	5,858	5,467	
Crude stocks	245,150	241,500	250,932	245,150	250,932	— 2
Days supply	39	38	45	39	45	
Natural gasoline production	14,600	14,550	13,935	145,051	127,287	+14
Daily average	471	485	450	477	419	
Motor fuel production	91,300	86,800	83,185	844,115	798,543	+ 6
Daily average	2,945	2,893	2,683	2,777	2,627	
Gasoline yield, per cent	43.0	43.0	43.4	43.3	44.4	— 1.1
Motor fuel demand	87,300	86,900	82,120	841,944	796,486	+ 6
Daily average	2,816	2,897	2,649	2,770	2,620	
Motor fuel stocks	109,200	105,200	103,117	109,200	103,117	+ 6
Days supply	39	36	39	39	39	
Fuel oil production	75,880	71,275	66,385	669,492	630,794	+ 6
Daily average	2,448	2,376	2,141	2,202	2,075	
Fuel oil demand	73,930	69,190	66,310	769,722	672,078	+15
Daily average	2,385	2,306	2,139	2,532	2,211	
Fuel oil stocks	131,100	120,150	159,316	131,100	159,316	—18
Days supply	55	52	74	55	74	
Refinery still runs	190,700	180,650	166,568	1,719,131	1,617,014	+ 6
Daily average	6,152	6,022	5,373	5,655	5,319	
Stocks, all oils	600,195	580,460	626,768	600,195	626,768	— 4
Days supply	91	86	104	91	104	

Current Crude Oil Prices

U. S. average	$2.58	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.62	Mississippi	2.23
Kansas	2.62	Illinois	2.76
		Other states	2.60

Basic crude prices:

Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.80
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.31
Pennsylvania, Bradford	4.00

Drilling and Production Statistics

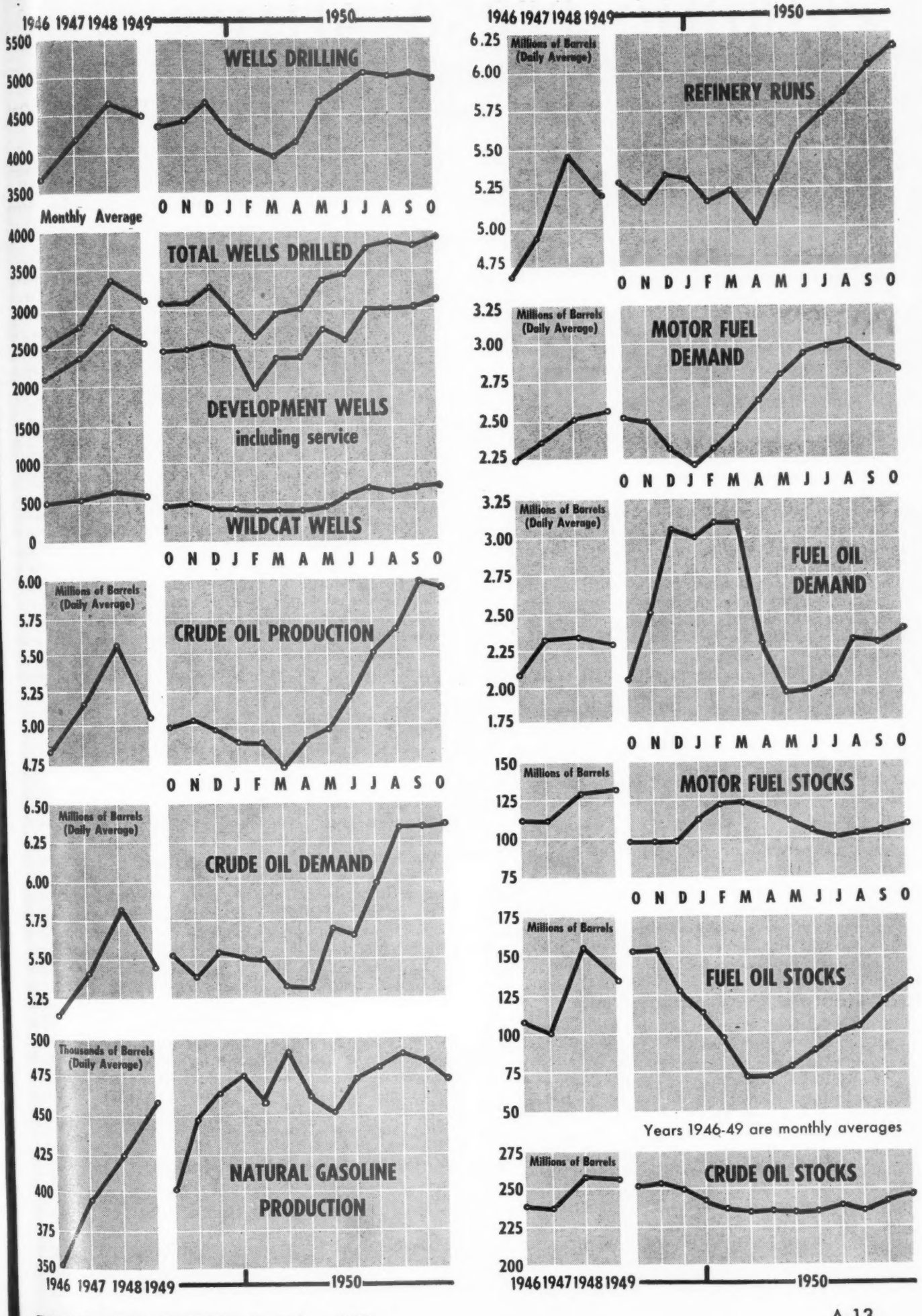
	Oct. 1950Ⓟ	Sept. 1950Ⓡ	Oct. 1949	This Year to dateⓅ	Last Year to date	Per cent change
Wells drilling	4,940	5,045	4,615	4,940	4,615	+ 7
Total wells drilled	3,994	3,844	3,315	35,410	32,017	+11
Development wells	3,121	3,027	2,640	28,141	25,357	+11
Oil	1,994	1,973	1,747	18,944	17,065	+11
Gas	297	235	269	2,243	2,291	— 2
Dry	830	819	624	6,954	5,991	+16
Per cent dry	26.6	27.1	23.6	24.7	23.7	+ 1.0
Service wells	100	80	107	703	1,005	—30
Wildcat wells	773	737	568	6,566	5,655	+16
Oil	125	107	89	1,008	882	+14
Gas	28	36	10	199	153	+30
Dry	620	594	469	5,359	4,889	+10
Per cent dry	80.2	80.6	82.7	81.6	86.5	— 4.9

By States

Wells drilled (excl. service)	3,894	3,764	3,208	34,907	31,012	+13
Arkansas	20	39	32	323	277	+17
California	175	164	205	1,533	2,126	—28
Illinois	318	271	222	2,427	2,124	+14
Kansas	427	302	309	3,120	2,704	+15
Louisiana	209	210	210	2,043	1,960	+ 4
Mississippi	26	26	27	267	284	— 6
New Mexico	42	47	46	507	406	+25
Oklahoma	468	410	369	4,412	3,486	+27
Texas	1,404	1,475	1,108	13,652	11,472	+19
Other states	805	820	680	6,423	6,173	+ 4
Wildcats drilled	773	737	568	6,566	5,655	+16
Arkansas	5	7	6	88	58	+52
California	45	38	44	360	421	—14
Illinois	63	59	65	556	426	+31
Kansas	88	93	40	651	430	+51
Louisiana	29	21	22	234	263	—11
Mississippi	19	7	11	115	92	+25
New Mexico	10	8	8	68	69	— 1
Oklahoma	71	79	65	717	659	+ 9
Texas	287	306	218	2,704	2,431	+11
Other states	156	119	89	1,073	806	+33
Daily crude production	5,945	5,960	5,029	5,341	5,030	+ 6
Arkansas	87	88	79	86	81	+ 6
California	929	921	877	917	920	
Illinois	171	176	177	171	177	— 3
Kansas	313	318	277	299	278	+ 8
Louisiana	603	590	538	566	517	+ 9
Mississippi	106	110	99	105	105	
New Mexico	131	140	131	131	131	
Oklahoma	500	492	419	445	413	+ 8
Texas	2,702	2,715	2,052	2,251	2,029	+11
Wyoming	168	174	123	162	128	+27
Other states	235	236	257	208	231	—10

* Unless otherwise stated all figures represent thousands of barrels. ‡ Total demand, including exports. • Includes domestic production and imports. Ⓟ–Preliminary. Ⓡ–Revised.

Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.


1946 1947 1948 1949
1950
WELLS DRILLING
5500
5000
4500
4000
3500
O N D J F M A M J J A S O
Monthly Average
4000
3500
3000
2500
2000
1500
1000
500
0
TOTAL WELLS DRILLED
DEVELOPMENT WELLS
including service
WILDCAT WELLS
O N D J F M A M J J A S O
Millions of Barrels
(Daily Average)
6.00
5.75
5.50
5.25
5.00
4.75
CRUDE OIL PRODUCTION
O N D J F M A M J J A S O
Millions of Barrels
(Daily Average)
6.50
6.25
6.00
5.75
5.50
5.25
CRUDE OIL DEMAND
Thousands of Barrels
(Daily Average)
500
475
450
425
400
375
350
NATURAL GASOLINE
PRODUCTION
1946 1947 1948 1949
1950
Millions of Barrels
(Daily Average)
6.25
6.00
5.75
5.50
5.25
5.00
4.75
REFINERY RUNS
O N D J F M A M J J A S O
Millions of Barrels
(Daily Average)
3.25
3.00
2.75
2.50
2.25
MOTOR FUEL
DEMAND
O N D J F M A M J J A S O
Millions of Barrels
(Daily Average)
3.25
3.00
2.75
2.50
2.25
2.00
1.75
FUEL OIL
DEMAND
O N D J F M A M J J A S O
Millions of Barrels
150
125
100
75
MOTOR FUEL STOCKS
O N D J F M A M J J A S O
Millions of Barrels
175
150
125
100
75
50
FUEL OIL STOCKS
Years 1946-49 are monthly averages
Millions of Barrels
275
250
225
200
CRUDE OIL STOCKS
1946 1947 1948 1949
1950

PETROLIC PERSONALITIES

DICK SNEDDON

Out of the Night That Was 50 Below

In 1923, clad in parka and mukaluks, we came out of the frozen north, landed in the City of the Angeles (more or less) where all was sunshine and warmth, and, completely unknown, began to look around for something wherewith to keep the wolf away from the garage. We made application with a firm of chemists, named Payne & Baverstock or something like that, and we weren't given a job, but we were promptly taken in tow by Mr. Payne, a kindly gentleman who seemed determined to find someone who could use our limited talents. He did, too, but it is of a prior experience that we would speak. One day he took us to a lunch meeting of the American Chemical Society, and we remember very vividly that the speaker of the day was a short, somewhat pale, but mighty dynamic individual, named Gustav Egloff. Even then, at the age of 37, Dr. Egloff had already accomplished more than most people do in a lifetime. Eight years before he had acquired his doctor's degree at Columbia University, and hadn't had a single idle minute since. He was by this time research director for Universal Oil Products Company of Chicago and the mounting grist of his accomplishment marked him as one of the most prolific producers in the scientific field. Literally brimming over with confidence and energy he turned out the most abstruse tomes and treatises with complete nonchalance, meantime speechifying and prophesying here, there and everywhere with a rare abandon. His knowledge of industry in general is terrific, and what he doesn't know about the petroleum hydrocarbons—well, nobody knows. He has had more honors heaped upon him than the Maharajah of Rajpuatana and the list of technical organizations to which he belongs is endless. He has written over 600 articles, and the fifth volume of his work on Physical Constants of the Hydrocarbons is just being readied for the press. He has had issued to him over 300 patents, and altogether is about as prodigious as any prodigy we have even known. Sportswise the doctor is no slouch either. Early in his career, he became quite a cyclist in New York, winning several sprint events in the old Madison Square Garden, and doing right well too in the longer road races outside. While at Cornell, where he received an A.B. in 1912, he was a proponent of what is now known as "grunt and groan" and, indeed, won an intercollegiate wrestling contest in the 125 pound class. The record shows that he was also a sharpie at swimming, could belt a golf ball with the best, and at canoodling in a canoe had no equal. An amazing person this Dr. Egloff!

Old Stanford Grad Makes Good

Another fabulous character about whom we have often been tempted to expatiate is Bart Gillespie of the Compania Independiente Mexicano Americana—better known as CIMA. We had a brief session with Bart recently at the Los Angeles Petroleum Club when he dropped in from Mexico City for a powwow with his CIMA principals. Here, we believe, is the best known and most universally loved individual in western oil. Bart was born in Yuma, Arizona, reared in Texas and Mexico, and came to the Santa Maria in 1908. Here in California he graduated from Stanford with a degree in geology and petroleum engineering, in 1918, but began work some 5 years before that on the old Union Oil Company Escolle Lease up Orcutt way. That, we imagine too, is where he came to know Porter Clevenger, one of Orcutt's most prominent civic workers, and, according to Bart, a natural born ball player who might easily have made the big leagues had he fallen into the right hands early enough in his life. Then there was the late Bill Watkins, another Union Oiler—one of the best—with whom Bart adventured in the first world war.

Has Charge of Aleutian Sea Bees

After graduation from Stanford, Bart went to Tampico, Mexico, for Atlantic Gulf & West Indies Corporation, after which he returned to California and did some roughnecking among other things for CCMO, becoming acquainted in the process with Ward Blodget, possessor of the loudest singing voice in oildom, and F. J. Ripley, Sr., the gentlemanly prexy of the CCMO outfit. That all took place in 1921, and we next find Bart working for Elliott Core Drill Company, with which organization he stayed until 1935, garnering a fine experience in all aspects of the drilling business. He left that company in 1935 and went up to Utah where he drilled for Glen Ruby the famous Ruby Geyser, a copious producer of CO_2 and water. Thence, not being one to take root too easily, he proceeded to Ganzo Azul in the Peruvian Amazon and for a couple of years officiated as field manager on a private venture for Seeley Mudd, Bob Moran, and Bill McDuffie. By 1938 he was back in California with Drillex for a year or so, then off to Argentine for a spell as technical advisor to Yacimientos Petroliferos Fiscales. When the war broke out he went into the Sea Bees and had a regiment of them under his command up in the Aleutian chain. Then he was named special assistant at Washington to Vice Admiral Ben Morreel, in charge of petroleum matters for the Bureau of Yards and Docks.

Hopes To Settle Down In Taxco

Next he organized the Arctic Expedition, having as its objective among other things, the exploration and exploitation of U. S. Naval Reserve No. 4 at Point Barrow, Alaska. He remained in charge of operations as Captain of the Sea Bees until February 1946 when he was placed on the inactive reserve and promptly became more active than he had been when he was on active duty. Anyway, at this stage he took over for the Arctic Contractors as project chief and continued in that capacity until 1947. He went down to Mexico City for CIMA in 1949 and still makes his headquarters there. For amusement Bart says he doesn't play the worst golf game in the world but something dangerously close to it. He belongs to the American Club in Mexico City and knows its surroundings intimately, but of its fairways he knows little or nothing. For a bit of emotional excitement, Bart repairs to the bull fights on Sunday and really enjoys all the glamour and color that are associated with these events. He, of course, speaks Spanish like a native and claims that if he ever had any inclination to retire which he hasn't yet, he would settle down in Taxco, which he thinks presents an unusual opportunity for comfortable and interesting living at very low cost.

Whispers From Brook Hollow

Chester Donnally, a native of Albuquerque, New Mexico, by birth, and a resident of Dallas, Texas, by choice, has just as we write been appointed vice president in charge of Mid-Continent operations for Grant Oil Tool Company and MacClatchie Manufacturing Company. Chester is a tall, substantial looking chap, easy to talk to and conse-

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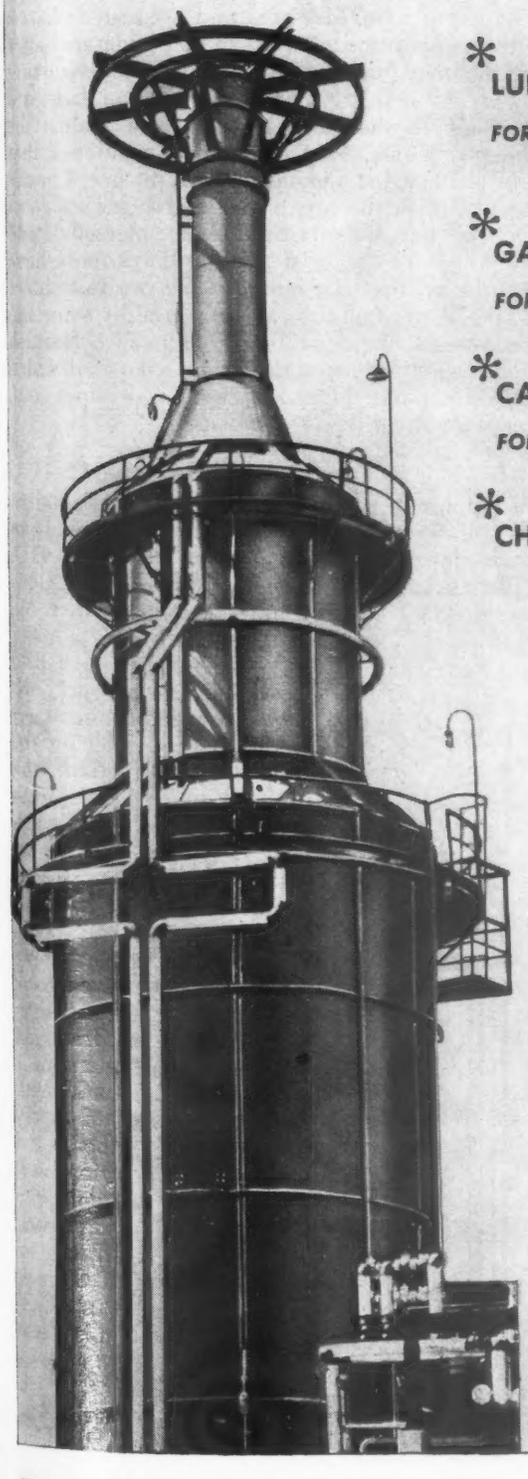

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quently easy to talk about. A graduate of SMU with the degree of BS in geology, he has searched widely through the oil states for the black Golconda, and has made a lot of friends in the oil producing areas.

He is, we hear, a popular member of the Brook Hollow Country Club at Dallas whence he hies on weekends with his trusty mashie to knock slabs of earth out from under a tiny, aggravating, indented rubber sphere — the same, incidentally, that once turned our own natural serenity into a shambles.

He is modest enough to admit that when it comes to the science of stances and swings he is no paragon and we suspect that really his first love sportswise is tennis. At least it is true that on a recent visit to the west, we happen to know that what little spare time he had was spent at the Los Angeles Tennis Club, where the cream of western lobbers and smashers congregate to keep their hinges in good working order and where Chester engaged some of their hotshots in heated contest. We deduce that he is a pretty proficient performer with the overweight fly swatter because he certainly knows the basic strategy of top tennis performance as we discovered in a brief chat with him some weeks ago.

And, if we do say so ourself, which we hadn't ought, having once won an eyeshade in a Canadian playgrounds tennis tournament for indigent boys, we feel fully competent to judge of the tennis acumen of others.

Big Game Hunters—Baseball and Moose

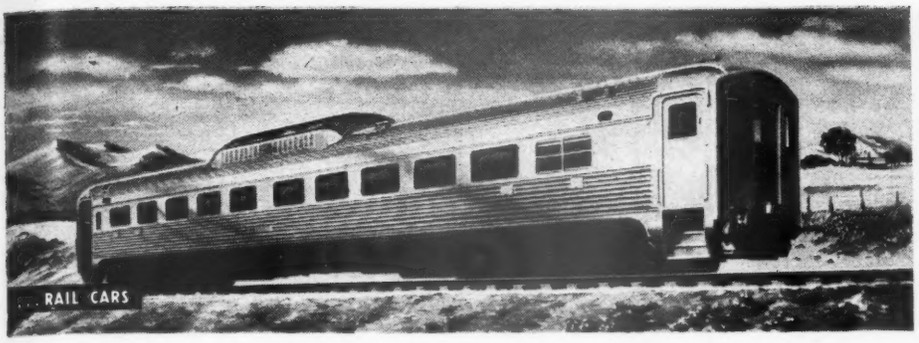
To lunch a short time ago with the ubiquitous chap. Tommy Johnston, formidable member of the M. O. Johnston enterprises and one of the best raconteurs in the petroleum industry, which is certainly saying something. Tom had the pleasure of sitting in the Casey Stengel box this year at the World's Series games in Yankee Stadium. That in itself is a distinctly exciting and exhausting experience. He probably could have taken it if he hadn't made the fatal mistake of trying to keep up with his mother. The little lady nearly reduced Tom to complete and permanent incompetency and gave him more walking exercise than he has had in many a year. As nearly as we can determine, Tom took his mother to New York, but she certainly brought him back, or he never would have made it. Incidentally, with him at the time of our meeting was the M. O. Johnston organization's Canadian manager from Edmonton, Joe Barlow, a Cookville, Tennessee boy who left the deep south and came to California about 1934. For the next 9 or 10 years he was with Standard of Cal up in the Bakersfield district, then he joined up with the Johnston people as a field tester. Joe is a member of the Edmonton Petroleum Club, the Calgary Petroleum Club, the Edmonton Chamber of Commerce, and is an intrepid hunter of golf balls and big game. As a big game hunter, it might be mentioned that last season while out on a trip with Willis Gibson, district petroleum engineer of Imperial and Rod Morris, district geologist of the same institution, he bagged a real live moose. On this same hunting trip he claims to have seen a mountain lion, but it had a very poor expression for a rug so he let it go.

A Softball Saga

Now, in line with our usual policy of keeping up with the important news, Austin, Texas, operative No. 41 tells us that the Chiksan softball team from Brea, California, gave a really swell account of itself in the World's Championship tournament there in mid-September. This fine aggregation, under the management of George Bagsley, was beaten by the defending champions and ultimate winners, Tip Top Tailors of Toronto, Canada, after a dingdong battle that was only decided in the last half of the ninth inning. The champs were down 4 to 2, with two men gone and two men on bases, and just at this inopportune moment, an inconsiderate batter whanged out a homer bringing in three runs and disgusting George Bagsley no end. However, the Chiksan lads did themselves proud. It was tough to be thrown against the champs in the first game. Also, it might be mentioned that they were up against that famous colored pitcher, Charlie Justice, known all over the country as the Satchel Paige of Softball. Even so, they did nobly and we are pleased to add our congratulations to the grist that the boys must have received. You know, that last inning home run just shows how quickly the tenor of affairs can be altered by some untoward circumstance. We remember reading in a Scottish newspaper once about a funeral during the course of which the grave digger expired. "This sad event," the paper said, "cast quite a gloom over the proceedings."

Chit Chat

By way of last minute roundup, Harris Cox, the Canadian representative of Western Geophysical International from Edmonton was down at the Los Angeles Petroleum Club recently sharpening up his domino game. Another big doubles tournament is under way there now, with Reg Keans and Ray Stipek, the Club champs defending their laurels against some of the stoutest competition the domino world has ever known. And we hate to confess it, but twice lately we have been taken for a row of double fives by the Huntington State smoothie, Tom Sherman. We are beginning to think he must have a book on the game or something. Foy Schlittler, the Grant and MacClatchie sales manager is still foraging around South America. Glimpsed Harry Hillman, Tex Talbert, and Charlie Eastman trying to explain to Bart Gillespie why Stanford wasn't doing so well this year. As nearly as we could understand them, it seems that the low standing of the Stanford team is due to the fact that they are not winning enough games, which sounds logical enough. Now we leave for the API whirl.



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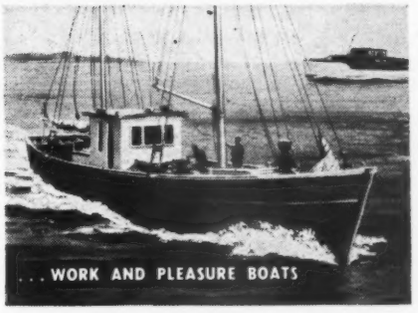

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April 23-25—Southern Gas Association, Buena Vista and Edgewater Gulf Hotels, Biloxi, Mississippi.

April 25-27—Natural Gasoline Assn of America, Annual Convention, Mayo Hotel, Tulsa, Oklahoma.

April 29-May 4—American Gas Assn, Industrial and Commercial Gas Section, Industrial Gas School, William Penn Hotel, Pittsburgh, Pa.

April 30-May 2—American Geophysical Union, Annual Meeting, National Academy of Sciences, Washington, D. C.

April 30-May 3—American Petroleum Institute, Division of Refining, Mid-Year Meeting, Mayo Hotel, Tulsa, Oklahoma.

May 6-9—Liquefied Petroleum Gas Assn, Annual Convention and Trade Show, Stevens Hotel, Chicago, Illinois.

May 10-11—API, Division of Production, Pacific Coast District, Spring Meeting, Biltmore Hotel, Los Angeles, Calif.

May 13-16—AIChE, Regional Meeting, Hotel Muehlebach, Kansas City, Mo.

May 14-16—AGA, Operating Section, Production and Chemical Conference, Hotel New Yorker, New York, N. Y.

May 28-June 6—Third World Petroleum Congress, Kurhaus, Scheveningen, Holland.

June 16-20—Canadian Gas Assn, Bigwin Inn, Lake of Bays, Ontario, Canada.

June 18-22—American Society for Testing Materials, Annual Meeting, Atlantic City, N. J.

Sept. 10-14—Instrument Society of America, Sixth National Conference and Exhibit, Sam Houston Coliseum, Houston, Texas.

Sept. 12-14—National Petroleum Association, Hotel Traymore, Atlantic City, N. J.

Sept. 16-19—American Institute of Chemical Engineering Regional Meeting, Sheraton Hotel, Rochester, N. Y.

Oct. 15-18—American Gas Association, Annual Convention, St. Louis, Missouri.

Oct. 14-20—Oil Progress Week.

Nov. 5-8—API, Annual Meeting, Palmer House and Stevens Hotel, Chicago, Ill.

Dec. 2-5—American Institute of Chemical Engineers, Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

NOMADS TO MEET

New York, N. Y., Chapter, First Monday of the Month, Louis Sherry's, New York, N. Y. Sec. Russ V. McIntire, 11 West 42nd Street, New York 18, New York.

Houston Chapter, Second Monday of the Month, Ye Ole College Inn, Houston, Texas. Sec. Harry E. Estes, P. O. Box 9321, Houston 11, Texas.

Los Angeles Chapter, Second Wednesday of the Month, Jonathan Club, Los Angeles, Calif. Sec. John W. Rife, 5905 Pacific Blvd., Huntington Park, Calif.

Tulsa Chapter, Third Wednesday of the Month, Hotel Tulsa, Tulsa, Okla. Sec. G. W. Davidson, Jr., Box 1188, Tulsa, Oklahoma.

Dallas Chapter, Dallas, Texas, First Monday of the Month. Sec. C. J. Berlin, Box 2968, Dallas, Texas.

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LETTERS *to the* EDITORS

Construction Costs

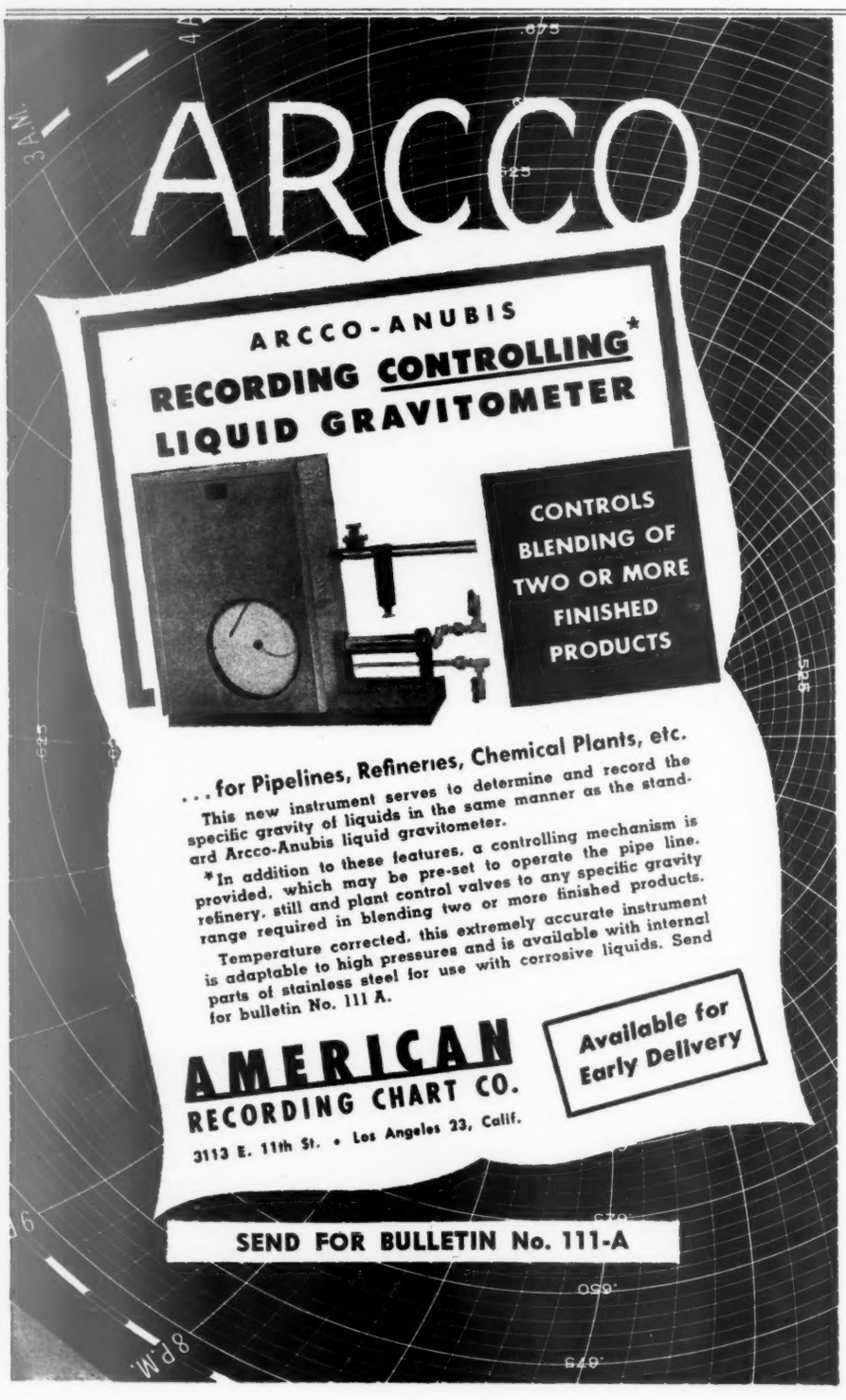
To The Petroleum Engineer:

The articles by George E. Brooks on "How to Estimate Plant Construction Costs," which have been published in *The Petroleum Engineer*, are of great interest to our engineers here. We should like very much to secure reprints of the articles. Do you have any available now or will you have after the complete publication has appeared?

Marian Wickline.

Librarian,
Great Western Division,
The Dow Chemical Company.

Editor's Note: *This 3-part article was reprinted because of many requests and made available to readers.*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Temperature corrected, this extremely accurate instrument is adaptable to high pressures and is available with internal parts of stainless steel for use with corrosive liquids. Send for bulletin No. 111 A.
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Rod Pumping

To the Petroleum Engineer:

We would like to obtain three reprints of the paper "A Simplified Method for Design of Rod Pumping Installation," which appears in the September 1950 issue of *The Petroleum Engineer*.

L. H. Moore.

Superintendent Production,
Gulf Refining Company,
Shreveport, Louisiana.

Faithful Reader

To The Petroleum Engineer:

. . . I am a faithful reader of your magazine and consider it of top value in the industry.

Rudolph A. Rivera.

Rio Piedras, Puerto Rico.

The Competitive System

"The most vital factor in the growth and development of the petroleum industry has been our demonstrated ability, under the competitive system, to supply the consumer with adequate quantities of high-quality products, when and where needed, at lowest cost. When the public consciousness is aroused to this truth, the industrial liberties and freedoms of the oil industry will be safe from attacks of those who would nationalize the business and industrial enterprise of this nation.

"Today, as in 1917, we face the possibilities of war. We face certainly a long period of mobilization—a mobilization which we pray will bring ultimate peace.

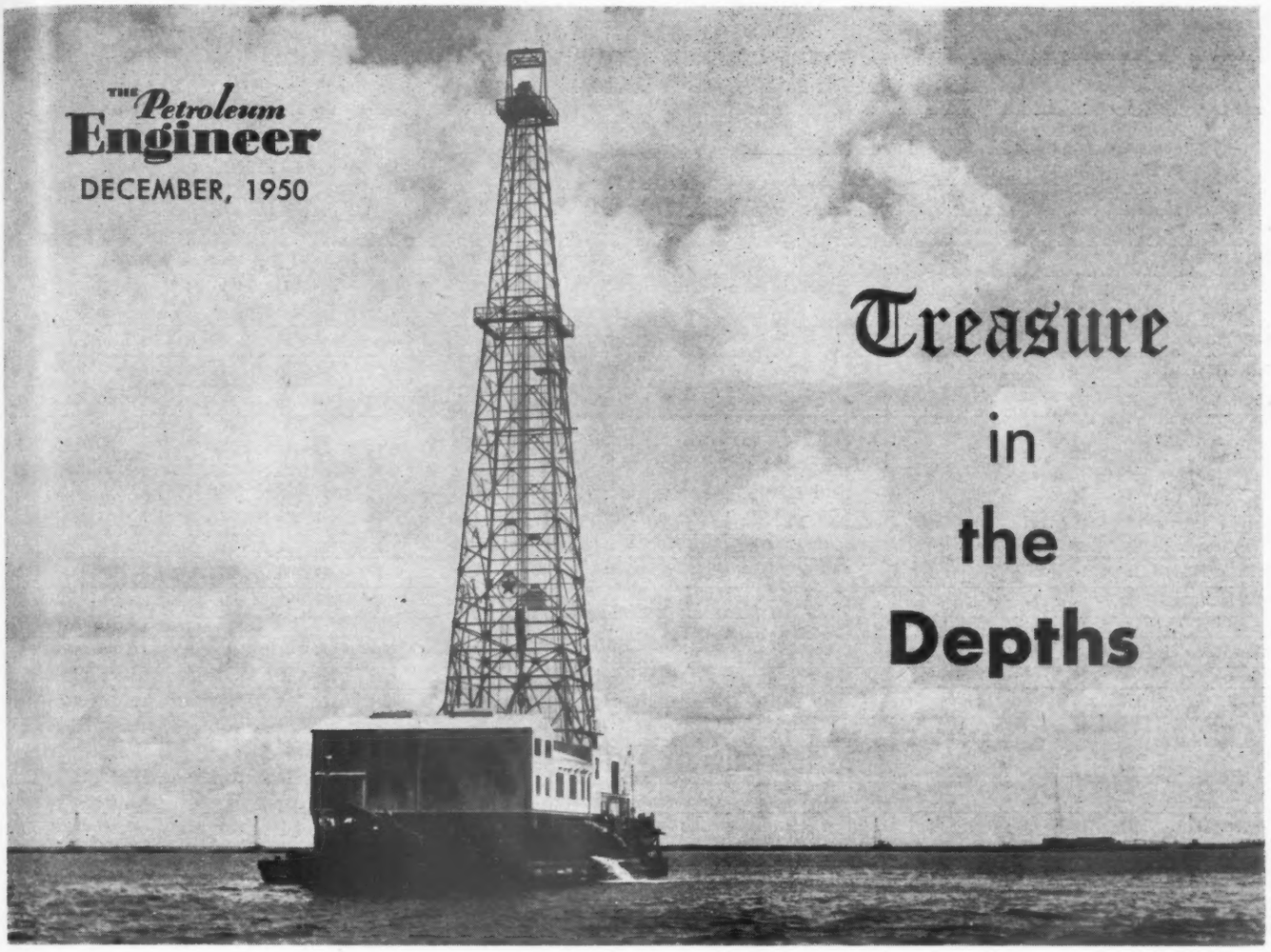
"The industry is preparing to meet a present or long-term emergency. Once more its members are patriotically volunteering their individual service to the mobilization effort.

"Again the oil industry is prepared to confirm what the founders of the American Petroleum Institute proved—that initiative, under free enterprise, is the best guaranty of the military security and the economic well-being of the people of America.

"Through unity, I have every confidence the oil industry will meet the critical problems it now faces."

Frank H. Porter.

President, API
Los Angeles, California
November 15, 1950
Annual meeting



Deep drilling experience has made it possible to explore the deep strata of the tidelands with greater safety and more confidence in successful completion. Above, a drilling barge of The Texas Company equipped with an Ideal Type 160 Consolidated rig designed to reach 16,000 to 20,000 ft.

One out of 3 wildcats that reached 12,000 ft in the last 15 years found production so that the $300,000,000 total cost is balanced.

ERNESTINE ADAMS*

FOR 15 years the oil industry has been probing that section of the earth from 12,000 ft to 20,521 ft below the surface in its eternal search for more oil and gas. Since Drake's 69½-ft wildcat was drilled, oil operators have gone deeper and deeper to find new and profitable fields. Under old fields and in wildcat territory there is new assurance of successful deep drilling and a reasonable chance of production. So the drill grows bolder as time goes on.

In 1935 Gulf Oil Company made the first test below 12,000 ft. The J. T. McElroy 103 in West Texas went to 12,786 ft, at a cost of $415,000 (1935 dollars). So was launched the Plutonian project of drilling 2, 3, and nearly 4 miles into the earth. In 15 years (to the first of this year) a total of 832 wells penetrated this deep sector and it is with the story of these wells that we are concerned.

That first deep well in 1935 stood alone for two years, then 6 holes ventured below 12,000 ft in 1937. Reward came for this courageous venture when two fields were found below 13,000 ft in 1938. Continental opened

*Managing Editor.

EXCLUSIVE

TABLE 1. Deep drilling and deep discoveries by years.

	Deep Holes Drilled	Deep Field or Deep Sands Discovered
1936	1	
1937	6	
1938	13	2
1939	26	
1940	16	
1941	19	1
1942	16	
1943	17	1
1944	38	
1945	76	2
1946	95	9
1947	115	6
1948	168	17
1949	226	19
Total	832	57

TABLE 2
COMPILED DATA ON ALL WELLS DRILLED BELOW 12,000 FT BY STATES TO JANUARY 1, 1950

(Details on counties or parishes with large numbers of deep wells are given below their states)

Location	Total no. wells drilled	Wildcats									Field wells			Deep tests completed as FW	Avg. drilling time	Avg. no. bits used			Avg. mud cost‡	Avg. well cost	Avg. depth	Avg. cost per ft.
		Total	Discoveries below 15,000	14,000	13,000	12,000	11,000	10,000	Above 10,000	No. dry	Total	Prod.	Dry			Rock	Drag	Total§				
ALABAMA	2	2	..	..	..	..	..	..	..	2	...	..	..	..	...	...	..	...	.....	.....	....	.....
CALIFORNIA	156	80	1	1	3	7	4	2	4	58	76	63	7	6	210	207	9	189	$ 15,000	$376,000	13,186	$28.51
Kern	82	47	1	..	2	2	1	2	3	36	35	26	5	4	200	209	11	184	13,000	335,000		
Los Angeles	14	12	..	1	..	1	2	..	1	7	2	...	..	2	278	280	5	240	20,000	451,170	.....	.....
Ventura	47	9	..	..	1	2	..	..	..	6	38	36	2	..	177	183	..	184	.....	392,940	.....	.....
COLORADO	2	2	..	..	..	..	..	..	1	1	...	....	..	..	...	...	..	...	.....	.....	.....	.....
FLORIDA	9	9	..	..	..	..	..	..	..	9	...	..	..	..	271	65	11	68	20,000	382,000	12,981	29.43
LOUISIANA	418	308	..	2	15	15	33	22	23	198	110	80	23	7	118	41	16	55	25,000	288,000	12,730	22.55
Cameron	20	18	..	..	..	..	..	2	2	14	...	...	..	1	151	66	20	67	30,000	303,000	.....	.....
Iberia	50	21	..	..	3	1	2	1	1	15	29	23	6	..	130	56	16	74	28,000	340,000	.....	.....
Jefferson	25	20	..	..	2	..	1	2	5	10	5	2	3	..	97	36	8	44	50,000	335,000	.....	.....
Lafourche	38	28	..	2	3	2	5	2	1	15	10	9	1	..	97	34	21	53	32,000	266,000	.....	.....
Plaquemines	35	26	..	..	1	2	5	..	2	16	9	7	2	..	128	29	18	50	15,000	300,000	.....	.....
St. Martin	22	13	..	..	..	2	1	1	1	8	9	8	1	..	124	59	17	71	20,000	334,000	.....	.....
St. Mary	37	29	..	..	1	2	3	1	2	21	8	6	2	..	101	61	12	62	19,000	232,000	.....	.....
Terrebonne	65	51	..	..	5	3	7	4	4	28	14	10	4	..	109	17	17	31	29,000	250,000	.....	.....
Vermilion	33	26	..	..	..	1	5	1	2	17	7	5	2	..	107	21	22	45	9,000	232,000	.....	.....
MISSISSIPPI	16	14	..	..	..	1	..	1	1	11	2	1	1	..	179	64	46	103	14,000	301,000	12,980	23.19
NEW MEXICO	21	15	..	..	..	2	..	..	2	11	6	6	..	...	209	213	2	213	18,000	326,000	12,606	25.86
Lea	19	13	..	..	..	2	..	..	2	9	6	6	..	..	216	213	2	213	17,000	326,000	.....	.....
OKLAHOMA	26	21	..	..	..	3	..	2	4	12	5	4	1	..	341	196	1	196	33,000	475,000	13,288	34.09
Grady	11	6	..	..	..	2	..	..	..	4†	5	4	1	..	334	168	..	168	32,000	20,000	.....	.....
TEXAS	163	134	..	..	1	4	8	12	31	78	29	13	7	9	221	121	8	128	62,000	420,000	12,898	32.64
Brazoria	18	11	..	..	..	..	2	2	3	4	7	3	4	..	168	56	31	80	48,000	352,000	.....	.....
Gaines	11	9	..	..	..	1	1	1	..	6	2	1	..	1	410	237	14	251	123,000	848,000	.....	.....
Montgomery	11	7	..	..	..	..	1	1	2	3	4	3	1*	..	203	64	..	64	100,000	380,000	.....	.....
Upton	14	7	..	..	..	2	1	2	2	...	7	5	2	..	168	162	..	162	.....	404,000	.....	.....
UTAH	2	2	..	..	..	..	..	..	..	2	...	...	..	..	...	...	..	...	.....	.....	.....	.....
WYOMING	17	12	..	1	..	1	..	..	..	10	5	4	1	..	353	208	..	208	41,000	567,000	13,475	42.08
U. S. TOTALS	832	599	1	4	19	33	45	39	66	392	233	171	40	22	173	...	..	107	.....	360,000	12,887	27.94

* Gas Injection Well. † Two produced some oil and gas. § Total bits includes the ones where type was not specified. ‡ For the year 1949 only.

the deep Wasco pool in Kern County, California and Fohs opened the De Large field in Terrebonne Parish, Louisiana. Inspired, the industry drilled more deep ones in the next two years but not where there was oil or gas. Deep drilling rocked along with never much to show for it. In 1944 alone 38 more of these giganic earth augers went down without a new deep pool showing.

Then Shell tapped a couple of bonanzas with deep production in Ventura Avenue field, California and a grand new discovery at Weeks Island, Iberia Parish, Louisiana. New sands are continuing to show up at the petroleum version of a multiple decker sandwich known as Weeks Island. There were only these two deep pools out of 73 tries but they heralded the turn of fortune. In 1946 one well out of 11 found production in the depths below 12,000 ft. A relapse to 1 for 19 in 1947 didn't last. The year 1948 saw a new deep pool in every 10 tries and 1949 one in every 12 holes drilled—19 new fields or new sands for 226 deep wells. (Table 1.)

These recent successes indicate not only that the operator is more expert at putting the drill two or three or four miles below the earth's surface but that he is more knowing about what to do when he gets there. Electrical surveys, proper mud systems, perforating, acidizing, control of high pressures, deep pumping—all these fairly recent technical advances have made it possible for the operator to produce what he does find.

It would be a mistake, however, to judge the results of deep drilling by the oil formations found below 12,000 ft. Deep drilling is a new exploratory dimension. Instead of covering a large surface area to a shallow depth, the deep well penetrates layers of formations from a small surface. Of the 832 deep holes we have termed 599 wildcats (Table 2). These include deep tests in proved pools that were not completed as field wells. The tests in deep formations completed as field wells are included with the development wells. This may be somewhat arbitrary but it was impossible for us to label some of the wells under Dr. Lahee's excellent classification. Deep tests that could not be completed as field wells were considered both extensions and deep tests and were therefore termed wildcats in this limited survey.

TABLE 3
DEEP WELLS BY DEPTH ZONES

Depth in feet	Number of wells
12,000—12,499	343
12,500—12,999	178
13,000—13,499	132
13,500—13,999	74
14,000—14,499	55
14,500—14,999	18
15,000—15,499	13
15,500—15,999	8
16,000—16,499	4
16,500—16,999	2
17,000—17,499	1
17,500—17,999	2
18,500—18,999	1
20,500—20,999	1
Total	832

Deep Test Discoveries

Out of the 599 deep wildcats 207 discovered new fields or new sands, which is less than 2 dry holes for each discovery. Several others had some production but were not considered good commercial risks.

Of these new fields and new sands, some 55 were discovered below 12,000 ft. A substantial portion of these deep fields are so far one-well pools and several have already been abandoned. In some instances it has been difficult to judge whether new production was from a new sand or an extension.

There also are a number of wells not included in the accompanying list that produced for a short time from deeper than 12,000 ft.

In Oklahoma, for instance, there have been several holes with production below 12,000 ft, which have not had sufficient commercial appeal. In Grady County Stanolind's Briscoe No. 1 flowed 138 bbl a day from 13,740 ft but the flow declined rapidly and the well was abandoned. In Caddo County, Denver Producing and Refining No. 1 School Land near Cogar, Caddo County, was completed as a gas well at 12,600 ft in 1948 but it was shut in as there was no available pipe line. In September, 1949 it was again tested and this time the volume did not appear desirable commercially so the well was abandoned.

Overall study of deep exploratory wells shows remarkable success considering the problems encountered and the short 15 years of experience. As we have seen, cumulative know-how has in recent years increased the probabilities of success.

The deep test, of course, has a much better chance of becoming a producer because of its greater penetration and there is naturally greater geological and geophysical study before locating a deep well, which is costly, than would be necessary for a shallow test. In comparing deep exploratory holes with Frederic H. Lahee's figures on all exploratory drilling from 1938 to and including 1949, we have:

	No. dry holes for each producer	Percentage of successful wells
All exploratory holes	4.5	18.5%
Exploratory holes below 12,000 ft	1.86	34.9%

These figures give the advantage to all exploratory wells because they include the deep wells. Deep tests are roughly three times the depth of the average exploratory well and are 2.7 times as successful.

Deep Development Wells

In all wells drilled to develop fields the average has been three producers to one dry well. The development wells in deep fields have done much better in comparison, having 5 producers for every dry development well. Of these only 22 were completed in shallow formations and the other 171 were completed from production below 12.000 ft.

From this it seems the unusually successful results for deep development drilling does not depend greatly on the greater number of strata penetrated, considering only 22 produce from upper formations.

The fact that few deep development wells are dry probably is traceable to greater caution in proceeding because of higher costs, just as greater care is observed in locating a deep wildcat.

Production Below 12,000 Ft

Because most of the deep fields are of recent date (Table 4), it would be rash to estimate their potential. It is interesting to note, however, that Pegasus field, Magnolia's find in West Texas, is considered the largest reserve discovered in 1949, regardless of depth. It has a proved potential of about 125,000,000 bbl.

In many cases there is no way of dividing the production below 12,000 ft with that just above. The Benedum field, also in West Texas, was brought in by Slick-Urshel's No. 1 Alford, which is still producing from 12,000 ft but all the other wells in the field are producing above that depth.

It is possible, however, to arrive at an estimate of cumulative production from the deep sector. This amounts to some 15,000,000 bbl of oil and condensate and some 80 billion cubic feet of gas produced in the 12 years since the first deep pool was discovered. Most of this oil and gas production has been in recent years.

One advantage has been gained recently by deep well producers in Texas. The Railroad Commission in March extended the discovery allowables for deep wells. All wells below 9000 ft formerly got 200 bbl quota; now the scale for 12,000 ft is 290 bbl going to 540 bbl for 14,000 to 14,500 ft. This gives deep producers a more equitable pay out quota.

Geographical Distribution

Of the 11 states that have tasted the deep drill, Louisiana stands way out in front (Table 5). Almost half the deep wells have been drilled on her lacy coastlands, along her rivers and bayous, and in the bordering Gulf of Mexico. More than half the deep fields are found there. Among others, there is Weeks Island, already mentioned; Tide Water's Manila Village where the operators conquered 12,600 psi pressure at 13,000 ft; The Texas Company's Leeville with four separate sands below 12,000 ft; Humble's Lake Raccourci, which holds great promise; Tide Water's Venice field, which has many strata not developed; De Large field, which Union Producing is operating now, and Superior's Four Isle.

Louisiana is the deep driller's dream —soft custard formation and few bit changes—until he hits that underground pressure that calls for tons of mud. It has a labyrinth of deep formations that only the drill itself can fathom.

Acknowledgment

One of the secrets of the progress and competence of the U. S. petroleum industry is its exchange of information. In the six annual deep well surveys companies engaged in deep drilling have freely supplied the data that has been compiled here. We appreciate the time and effort this involved and thank all 87 of them.

The trend is toward more deep drilling. Operators have shown their willingness to explore great depths at high cost. If oil is to be found they intend to find and produce it. The manufacturers back them up with rigs and equipment capable of exploring the depths so that these super wells can be drilled with safety and greater possibility of successful discovery.

Texas is the second most deeply drilled state with 163 deep wells. Drilling isn't easy but Pegasus and Benedum and Shell's Flanagan field show that if you hit you can have something that really pays for your trouble. Drilling is scattered all over the Lone Star state as you can see by the table showing a large number of counties with one deep well. Instead of the coastland, Texas deep discoveries are mainly in the West Plains country. They are close to the Upton County location where Gulf drilled that first deep well 15 years ago.

The third state in deep drilling, California, has the largest percentage of deep field wells. Of its 156 wells, 76 are development drilling. Ventura Avenue has 40 wells below 12,000 ft; Wasco field has 19, and Paloma 16.

Other states are far below these three deep-drilled veterans. Oklahoma has had only 26 deep holes, New Mexico 21, and Wyoming 17. Each of the three have turned up two remarkable discoveries, all in 1948 and '49 except Mountain Fuel Supply's Church Buttes gas field in Wyoming, which was found in 1946 and has since been patiently and successfully developing supply and markets.

Mississippi, with 9 deep wells, has one discovery, Gulf's Ovett field, which has been producing since discovered two years ago.

None of Florida's 9 deep tries has found oil nor have the two tests each in Alabama, Colorado, and Utah. In Utah, one deep well, Pacific Western Unit No. 1, Carbon County, found carbon dioxide and was dubbed the "ice cream well" but it has not been completed for commercial purposes.

The Operators

The surprising number of 87 different companies have drilled one or more deep wells (Table 6). The high cost and unusual skill required to complete successfully one of these deep

TABLE 4. FIELDS IN THE U. S. BELOW 12,000 FT.

County	Field	Discovery well	Discovery date	Deepest test, ft.	Production depth, ft.	Gravity, GOR	Total drilled below 12,000 ft.	Init. prod. disc. well	Cum. prod. 1/1/50	Remarks
CALIFORNIA										
Kern	Paloma	Western Gulf No. 54-1 P.U.	5/10/49	14,486	12,330	33°–52° to 9000:1	16	575 B 439 CF	435,600 B	Deep production in old field. Seven Gulf wells producing below 12,000′.
Kern	Shafter	Continental No. C-2 Kern County Land	10/31/41	13,064	12,800	36.8° 1025:1	5	488 B 500 MCF	45,971 B	Two deep producers in this field. Last one abandoned 1945.
Kern	Wasco	Continental No. A-2 Kern County Land	4/19/38	15,004 (until 49)	13,175	35.8° 454:1	17	3384 B 1536 MCF	1,200,000 B	Discovery was first 15,000′ test; first production below 13,000′. Continental abandoned its 5 deep Wasco producers in 1947.
Kern	Wasco	Standard of Calif. No. 5 Mushrush	9/8/49	15,866	15,530	40.4° 3460:1	2	352 B 1218 CF	27,000 B	Now producing 107 B/D from 90′ of Eocene sand, this is world's deepest production.
Kings	Kettleman Hls. Middle Dome	Standard of Calif. 73-30V Bolsa Chica	1/2/48	12,389	12,276	47.2°	2	530 B 5230 MCF	85,000 B	Present production both wells 193 B/D, 1900 MCF. Deep production in old field.
Los Angeles	Newhall-Potrero	Barnsdall No. 66-9 RSF	12/29/48	14,513	14,501	28°	1	50 B	9000 B	Deepest production at time of completion. New sand in old field 13,940′ —14,505′.
Los Angeles	La Mirada	General Petroleum No. 1 Librown	2/22/46	12,600	12,227 12,277 12,527	28°	1	250 B	20,571 B	Abandoned 3/27/47. Produced from perforations at three intervals.
Los Angeles	Seal Beach	Marine Exploration No. 2 State	11/7/48	13,907	12,300*	26.3°	1	65 B	15,415 B	New deep sand in old field. Some 300′ thick in Upper Miocene.
Ventura	Rincon	Chanslor-Canfield No. C-11 Hobson	10/17/46	14,155	13,560	27.5° 1296:1	1	26 B 14 MCF	54,958 B (8220′–13,560′)	Second deep well in this sand completed in 1950. Rincon is old field in upper levels.
Ventura	Ventura Avenue	Shell No. 44 Edison	9/17/45	14,130	12,112	30.5°	40	1096 B 866 CF	1,000,000 B†	Deeper production in known sand Lower Pliocene. One of important deep finds.
TEXAS										
Andrews	Warfield	Texas No. 1 Scharbouse	3/16/49	13,374	13,049	46.9° 687:1	1	44 B 30 MCF	8000 B 5500 MCF	Ellenberger field. Anticline structure. Not producing at present.
Chambers	South Mayes	Humble No. 1 South Mayes Unit	2/27/48	12,100	12,020	47.8° 10,000:1	3	134 B 1334 MCF	146,000 B 1633 MMCF (3/1/50)	Deep salt dome. New sand in old field. Two wells producing from below 12,000′.
Gaines	Flanagan	Shell No. 1 W. L. Hawkins	1/20/49	12,580	12,267	40.8° 225 1	3	844 B	144,572 B	New Ellenberger field. Three wells drilled into reservoir; only one completed as producer.
Midland & Upton	Pegasus	Magnolia No. 1-A TXL	3/15/49	13,295	12,700	52.3° 1403:1	3	1167 B	228,425 B	Largest field discovered at any depth in 1949. Ellenberger pay runs about 250′. Nearby General Petroleum's Sweetie Peck was early 1950 discovery.
Upton	Benedum	Slick-Urschel No. 1 D. L. Alford	12/6/47	12,591	12,022	59°	8	833 B 3660 MCF	219,792 B	In the productive Benedum field only this one well produces from below 12,000′. Field water level is 11,500 and other production is above this.
MISSISSIPPI										
Jones	Ovett	Gulf No. 1 L. L. Majors	1/5/48	13 825	13,080	31.2° 230:1	4	.....	49,180 B 11,593 MCF	Range of producing depth is 12,011-13,082′ and 7348–7380′.
NEW MEXICO										
Lea	Crossroads	Mid-Continent No. 1-A U. D. Sawyer	4/22/48	12,485	12,255	42.5° 43:1	6	3980 B 170 MCF	211,137 B	One of the richer deep fields being developed by Mid-Continent and Magnolia.
Lea	Knowles	Amerada No. 1 Hamilton	5/6/49	12,656	12,600	46.9° 180:1	3	935 B 160 MCF	109,004 B 1 801 MCF	Amerada has not had time to develop this promising 200′ thick Devonian No dry holes in three tries.
OKLAHOMA										
Grady	Chitwood	Magnolia No. 1 V. M. Powers	11/2/48	13,100	12,175	39.8° 1250:1	6	337 B	236,420 B	Deep sand in the old Chitwood field that produces just above 12,000′ Pennsylvania formation about 50′ thick.
Grady	N. E. Bradley	Gulf No. 1 Mainka	4/9/49	14,013	12,900 13,567	46.5° 1700:1	1	1068 B 1815 MCF	103,368 B	Discovered new field with 4 productive sands in First and Second Bromides. Faulted anticline structure.
WYOMING										
Natrona	West Poison Spider	Pure No. 1 West Poison Spider	7/10/48	14,309	14,309	43.6° 2004:1	1	898 B 1800 MCF	142,500 B (5/31/50)	This field is being developed in upper levels but No. 1 is still producing in Frontier sand. Was deepest production in 1948.
Uinta & Sweetwater	Church Buttes	Mountain Fuel Supply Unit No. 1	4/28/46	12,895	12,550	.....	7	32,000 MCF	9 billion CF	One of the important gas finds of recent years. Dakota sandstone. Considerable condensate and large quantities of gas found.

* Marine Exploration Company points out this is the length of the well as it is a directional well and production is not 12,000 in true vertical depth.
† Estimate of production from Shell's 6 wells only.

TABLE 4. *Continued.* FIELDS IN THE U. S. BELOW 12,000 FT.

County	Field	Discovery well	Discovery date	Deepest test, ft.	Production depth, ft.	Gravity, GOR	Total below 12,000 ft.	Init. prod. disc. well	Cum. prod. 1/1/50	Remarks
					LOUISIANA					
Acadia Parish	Branch 60′	Union Sulphur, No. 1 Kahn-Broussard	8/15/49	12,166	12,074	44.5° 56,000:1	1	34 B 1904MCF	5656 B 115,826MCF	New sand in old field. Chichasawhay formation, 82′ thick. Union Sulphur opened second deep sand in 1950.
Allen Parish	South Oberlin	Humble, No. 1-B Mrs. J. A. Bel Estate	2/9/46	13,150	12,650	47.5° 3221:1	1	130 B 419 MCF	19,000 B	Wilcox formation. This was new field.
Iberia	Rabbit Island	Texas, No. 11 State	8/2/48	12,656	12,446	.....	2	10,300 MCF	.....	Shale and lime. Not producing at present.
Iberia	Weeks Island	Shell Smith State Unit I, Well 1	4/30/45	15,913	13,110–13,125	34° 1177	25	471 B 554 MCF	520,500 B	Piercement type structure. Some 10 sandstones encountered below 12,000′
	Weeks Island	Shell Smith State Unit I, Well 2	4/6/46	15,913	13,763 13,778	34° 1980	25	454 B 857 MCF	550,500 B	
Iberia	Weeks Island	Humble No. 1 Fee	4/15/48	13,497	13,364	24.8° 600:1	1	250 B 155 CF	70,000 B (3/1/50)	Only discovery in Weeks Island structure by company other than Shell.
Jefferson	Queen Bess Is.	Texas, No. 1 Lafourche Basin Levee Dist.	7/23/47	15,523	13,904	44.1° 111,000:1	1	48 B 6188 MCF	1500 B (3/1/50)	Hard sandy shale and lime about 35′ thick.
Jefferson	Manila Village	Tidewater, No. 1 State Lease 1299	3/21/49	13,050	13,007	39° 5218:1	1	179 B 934 MCF	43,534 B	Producing sand about 22′ of Miocene shale and sand. Pressure was estimated at 12,600 psi, making a difficult completion.
Lafourche	Leeville	Texas, No. 5 (City of New Orleans)	1/5/48	15,014	12,900	47.9° & 60° 24,000:1	10	146 B	17,000 B	New sand on east flank of old field.
		Texas, No. 111 La. Land and Exploration	12/11/48	.....	14,000	28° & 60° 750:1	..	319 B	69,000 B	Shale and Lime pool on south flank of Leeville about 10′′ thick.
		Texas, No. 6 (City of New Orleans)	2/25/49	.....	13,300	48.9° & 60° 8300:1	..	92 B Cond.	7,000 B	Deeper producing formation-about 50′ thick.
		Texas, No. 1 A. J. Caillouet	8/4/49	.....	13,700	1780:1	..	276 B	2,300 B	New sand some 70′ thick.
Lafourche	Lake Raccourci	Humble, St. Lse. 1480 Lake Raccourci 1	9/19/49	14,923	12,135	56.2° 46,325:1	1	120 B 559 MCF	2,600,000 B 166 MMCF	Lake Raccourci field was discovered 4/15/49 on Humble Lease No. 1450 by well that went to 14,650 but was completed at 10,000. The third sand below 12,000′ was discovered in 1945 and is not included.
		Humble, St. Lse. 1452 Lake Raccourci 1	10/8/49	.....	14,434	48.4° 23,034:1	1	179 B 4123 MCF	Shut in.	
Lafourche	Golden Meadows	Spartan, No. A-1 P. C. Authement†	7/18/49	13,310	13,000	38°	1		70 B 2118 MCF	New deep sand in salt dome field. Completed in 10,700′ zone.
Plaquemines	Lake Hermitage	Gulf, No. 16 Lafourche Basin Levee Dist.	1/11/47	12,386	12,036	45.5° 39,080:1	4	81 B 3000 MCF	Shut in.	Shut in gas well. Salt dome structure. Later oil found at 11,740–950′.
Plaquemines	Venice	Tide Water, No. 29 Buras Levee Dist.	4/24/46	13,213	13,000	38.8° 1797:1	11	326 B	17,930 B	New deep sand in salt dome. Abnormal pressure which declined rapidly. Well recompleted (See below).
		Tide Water No. 29 Buras Levee Dist. (above well recompleted).	11/16/46	.....	12,050	37.1° 1162:1	..	284 B	21,079 B	Second sand found below 12,000′ in Venice salt dome. Recompleted in 11,520′ sand.
		Tide Water, No. 36 Buras Levee Dist.	8/14/47	.....	12,550	32.3° 881:1	..	243 B	7,178 B	New 16′ Miocene producing sand in field. Recompleted—see below.
		Tide Water, No. 36 Buras Levee Dist.	5/9/48	.....	12,765	36.2 1490:1	..	442 B	106,310 B	New sand in Venice field about 25′ thick. Recompleted in 10,590′ sand.
		Tide Water, No. 45 Buras Levee Dist.	12/17/49	.....	12,328	37.9 1440:1	..	374 538 MCF	1320 B	New sand in Miocene zone about 34′ thick. Recompleted in 11,302′ sand.
St. Martin	Duck Lake	Hunt Oil St. Lse. 1329 Goodrich Unit 1.	7/16/49	13,594	12,400	.....	7	102,000 MCF	2599 B 151,560 MCF	Deeper sand in Duck Lake field.
St. Martin	Sec 28	Gulf, No. D-3 St. Martin Land Co.	9/3/49	14,000	12,340	43.9° 90,400:1	8	224 3440 MCF	224 B Cond.	First production below 12,000′ in Sec. 28, making 9th producing level in salt dome field.
St. Mary	Cote Blanche Island	Texas, No. 12 State	4/29/48	15,140	13,300	136,000:1	4	7700 MCF	3500 B	Three dry tests were drilled before production was found in this anticlinal structure.
St. Mary	Horseshoe Bayou	Texas, No. 6 St. Mary Ph. Ld. Co.	4/12/48	12,932	12,000	35° 870:1	9	443 B	206,000 B	This was deeper production in known sand discovered in 1939.
		Texas, No. 9 St. Mary Ph. Ld. Co.	4/24/49	.....	12,024	33.3° 1200:1	..	291 B	38,600 B	Extension to sand.
Terrebonne	De Large	Fohs, No. 1 Buckley Bourg	6/26/38	15,470	13,266	50°	7	125 B 3000 MCF	.....	Record production depth at time of completion.
		Union Prod., No. 1 Fitzpatrick-Vizard	7/6/43	.....	13,490	.....	..	162 B 6264 MCF	900,000 cond. 100,000 oil 35 billion CF (7/1/50)	In 1944 De Large again had deepest producer at 13,503′, which came in with 518 B/D.
Terrebonne	Four Isle	Superior, No. 2 State LLE Unit 12	10/47	14,564	13,476	48.4°	6	180 cond. 2000 MCF	23 billion CF 380,000 cond. (6/1/50)	Superior has all wells in this deep field and all are producing from one of two sands.
		Superior, No. 1 LLE Unit 19	11/11/48	.....	12,220	38° 1170:1	..	294 B 344 MCF	5 billion CF 80,000 cond. 900,000 oil	Second sand below 12,000′. Four Island is on piercement dome structure.
Terrebone	Bay St. Elaine	Texas, No. C-1 State Lease	9/27/48	14,137	13,700	47.3° 76,000:1	3	78 B 2880 MCF	650 B	Deepest of 9 producing sands in Bay St. Elaine field. The Texas Company discovered a second pay sand below 12,000′ in 1950.
Terrebonne	Lapeyrouse	Placid No. 1 Dupont	10/24/46	14,430	12,640	60° 29,050:1	4	111 B 3235 MCF	Shut in.	Deep sand in old field.
Terrebonne	Lake Pelto	Texas, No. 50 State Lease	9/30/46	12,602	12,400	46° 1758:1	6	86 B 1605 MCF	120,000 B	Only one well in deep shale pay.
Vermilion	Broussard	Hassie Hunt Trust, No. 1 J. S. Broussard	3/22/49	12,636	12,100	43° 23,000:1	1	.....	23,842 B 345,630 MCF	New gas field. No market at present.

* Nearest 500 bbl.
† Two zones tested below 12,000′ had oil and gas but they were squeezed to complete in upper zone.

TABLE 5
Location of all wells drilled below 12,000 ft from 1935 to 1950.

State, County (or Parish)	Total
Alabama	2
Clark	1
Washington	1
California	156
Fresno	7
Imperial	1
Kern	82
Kings	5
Los Angeles	14
Orange	2
Tulare	2
Ventura	47
Colorado	2
Rio Blanco	2
Florida	9
Charlotte	1
Collier	4
Highlands	1
Monroe	2
Palm Beach	1
Louisiana	418
Acadia	5
Allen	1
Ascension	2
Assumption	8
Avoyelles	1
E. Baton Rouge	1
Beauregard	5
Bossier	1
Calcasieu	8
Cameron	19
Claiborne	4
Evangeline	16
Iberia	50
Iberville	7
Jackson	1
Jefferson	25
Jeff Davis	7
Lafayette	4
Lafourche	38
La Salle	1
Plaquemines	35
Rapids	1
St. Bernard	3
St. Charles	6
St. James	1
St. John Bapt	1
St. Landry	3
St. Martin	22
St. Mary	37
Terrebonne	65
Vermilion	33
Vernon	2
Washington	1
Webster	4
Mississippi	16
Adams	4
Forrest	2
Green	1
Jasper	1
Jeff Davis	1
Jones	4
Lincoln	1
Rankin	1
Stone	1
New Mexico	21
Chaves	2
Lea	19

State, County	Total
Oklahoma	26
Beckham	2
Caddo	4
Dewey	2
Garvin	2
Grady	11
McClain	1
Stephens	2
Washita	2
Texas	163
Anderson	2
Andrews	4
Aransas	1
Brazoria	18
Brazos	1
Brooks	2
Cameron	2
Chambers	7
Colorado	1
Crane	1
Culbertson	1
Duval	1
Ector	3
Freestone	2
Gaines	11
Galveston	4
Goliad	1
Gonzales	1
Grayson	1
Hardin	2
Harris	5
Jackson	1
Jefferson	4
Kenedy	2
Kleberg	2
LaSalle	1
Liberty	5
Lipscomb	1
Madison	1
Martin	1
Matagorda	7
McMullen	3
Midland	4
Montgomery	11
Newton	2
Nueces	4
Pecos	3
Reagan	2
Reeves	1
San Jacinto	1
San Patricio	2
Shelby	1
Smith	2
Starr	1
Terrell	1
Terry	1
Titus	1
Trinity	2
Upton	14
Waller	1
Willacy	4
Winkler	6
Wharton	1
Wood	1
Utah	2
Grand	1
Carbon	1
Wyoming	17
Freemont	2
Johnson	2
Lincoln	1
Natrona	2
Park	1
Sheridan	1
Sublette	1
Sweetwater	7

TOTAL—832 WELLS IN 11 STATES.

holes has not been limited to large operators.

The big companies, however, drilled most of the deep holes. Humble Oil and Refining Company had drilled 100 wells 12,000 or more feet deep by the first of this year. The Texas Company was close behind with 94. Gulf and Shell had more than 50 each; Magnolia had drilled 42 deep wells. Superior Oil Company, whose wells have held many depth records, drilled 39 below 12,000 ft before 1950. Superior's Pacific Creek well, Sublette County, Wyoming at 20,521 ft and its Limoneira well, Ventura, California at 18,734 ft are the deepest and second deepest wells in the world.

Stanolind, Tide Water, Continental, and Standard of California each had drilled more than 30 deep wells up to January. Standard of California has the world's deepest production in the Mushrush well, Wasco field, Kern County, California, which produces from 15,440-530 ft.

Contractors

A large share of all deep drilling is done by drilling contracting firms. In the last two years when records were kept of whether the operator did his own drilling, more than half the deep wells were put down by contractors.

If you reasoned it out, you would think that probably only a few big contracting companies were equipped to handle the special conditions of deep drilling. The facts are that 78 different drilling contractors in 1948 and 1949 have drilled from one to 32 deep wells in the U. S.

We hear of the spread of technical knowledge in our competitive free enterprise system. This is a clear indication of how it works. Instead of a few drilling contractors experienced in deep drilling there are 78 companies that have successfully completed at least one deep well in those two years besides the scores of oil companies whose drilling departments performed the same feat.

Cost

The cost is as high as the drilling is deep. For the 832 wells drilled in 15 years the oil industry has paid out approximately $300,000,000. The deep wells have cost all the way from $87,000 to $1,600,000 each and the average for all has been $360,000. Among other factors, cost revolves around depth, drilling time, bits, and mud. Fig. 1, a graph of Table 7, shows a definite tie between these factors and cost. In some cases one item accounts for unusual differences in cost. In Texas and Louisiana, for instance, mud costs have more influence on the total than in other states. Florida's drilling time and New Mexico's need for extra bits are unusual cost factors.

The extreme high cost of drilling in Wyoming is due to some extent to remote locations where rough terrain and water scarcity require road building and water well drilling. The 20,521-ft Superior well in the state raised the average; without it, costs in Wyoming and Oklahoma would be virtually the same. But Oklahoma has wells that have held record depths and have been drilled at record expense so there is no logical reason for eliminating any.

At the other end Louisiana's average cost would be considerably less if the wells off the coast in the Gulf of Mexico were not included. As new ventures, the 11 deep tidelands wells averaged $872,820 each.

Drilling Time

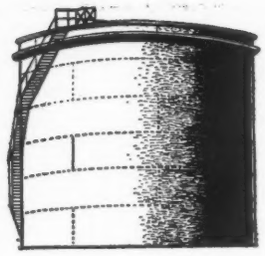
The time consumed in drilling deep wells is one of the chief factors in cost. Fig. 1 reveals the close association. In only one state is drilling time out of line with cost and that is in Florida. Low number of bits used and low mud costs together offset the long drilling time in this state.

There is a heartening sign that drill-

TABLE 6. DEEP WELL OPERATORS.

Operator	Deep wells drilled	Operator	Deep wells drilled	Each of the following drilled 1 well below 12,000 ft:
Amerada Petroleum Corp..	14	McCarthy Oil and Gas Co.....	4	Abercrombie, J. S. Company
American Republics Corp.....	2	Ohio Oil Co.....	4	Alliance Petroleum Corp.
Arkansas Fuel Oil Co.....	2	Pacific Western Oil Corp.....	5	Argo Oil Corp.
Atlantic Oil Co.....	8	Pan American Petroleum and		Belridge Oil Co.
Barnsdall Oil Co.....	6	Transportation Co.....	6	Callery, F. A.
British-American Oil.....	2	Phillips Petroleum Co.....	24	Coline Oil Corp.
Burton, W. T.....	2	Placid Oil Co.....	7	Four Star Oil Co.
California Co.....	15	Plymouth Oil Co.....	7	General Crude Co.
Carter, Amon G.....	2	Pure Oil Co.....	6	Havenstrite, R. G.
Chandler Canfield Midway Oil..	2	Quintana Petroleum Co.....	4	Helis, William
Chicago Corp.....	3	Republic Natural Gas Co.....	2	Hiawatha Oil and Gas Co.
Cities Service Co.....	3	Richfield United Oil Co.....	3	Honolulu Oil Corp.
Cotton Valley Operators Comm.	2	Richardson, S. W.....	5	Kings Company Oil Co.
Continental Oil Co.....	34	Seaboard Oil Co.....	2	Marine Exploration Co.
Denver Producing and		Shell Oil Co.....	51	McCrates, A. N., Sons
Refining Co.....	2	Sinclair Oil Corp.....	3	McGuire, T. S.
Fohs Oil Co.....	3	Skelly Oil Co.....	3	Norando Oil Co.
General Petroleum Corp.....	7	Slick-Urschel Oil Co.....	2	Norton, Richard W., Jr.
Gravis and Mitchell.....	3	Sohio Petroleum Co.....	7	Oklahoma Natural Gas Co.
Gulf Oil Corp.....	53	Spartan Natural Gas Co.....	3	Oil Development Co. of Texas
Humble Oil and Refining Co....	100	Standard of California.....	34	Robinson, O. D.
Hunt Oil Co.....	14	Stanolind Oil and Gas Co.....	38	Stewart Oil and Gas Co.
Kerr-McGee Oil Industries.....	2	Sun Oil Co.....	13	Strake, G. W.
Louisiana Land and		Superior Oil Co.....	38	Samedan Oil Corp.
Exploration Co.....	3	The Texas Co.....	94	Taylor Drilling and Producing Co.
Livermore, George P.....	2	Tide Water Associated Oil Co...	34	Tex-Harvey Oil Co.
Lloyd Corp.....	16	Union Oil Co. of Calif.....	20	Turner, Fred J.
Magnolia Petroleum Corp.....	42	Union Producing Co.....	14	Western Natural Gas Co.
Mid-Continent Petroleum Corp..	4	Union Sulphur Co.....	3	White Eagle Oil Co.
Mountain Fuel Supply Co.....	6	Western Gulf Oil Co.....	12	Wilshire Oil Co.

TOTAL NUMBER OPERATORS—87. **TOTAL WELLS TO 1-1-50—832.**



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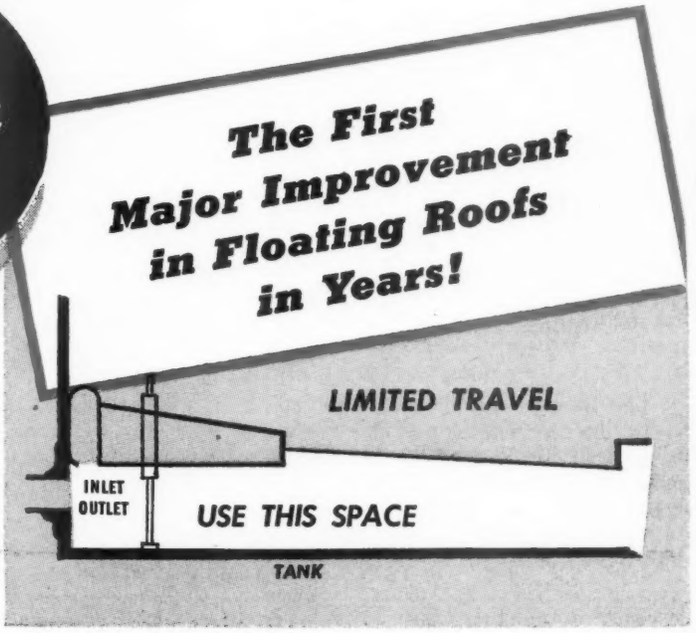

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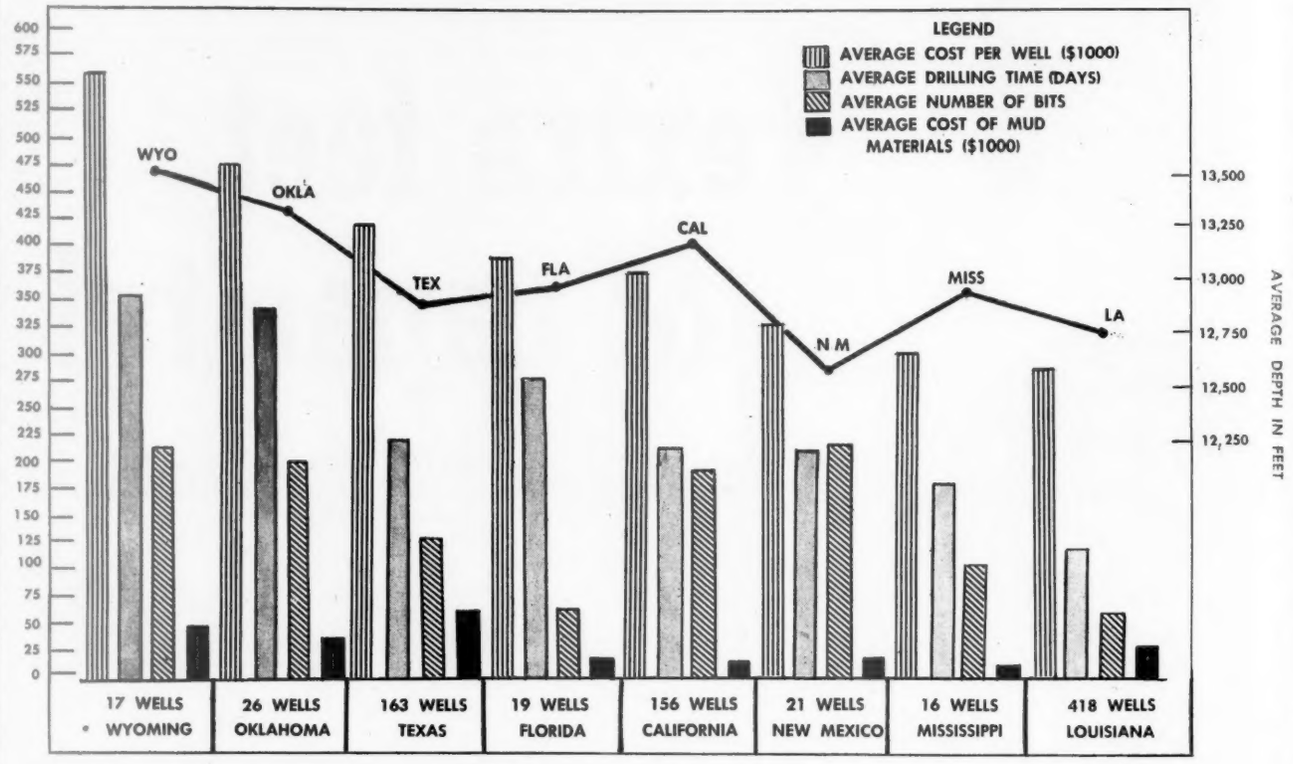


FIG. 1. Cost of deep wells by states puts Wyoming at head of list but the state also boasts the world's deepest well. New Mexico has highest bit average and Texas spends most for mud. Mud costs are for 1949 only.

ing time is diminishing with the greater experience of crews and improved machinery for deep drilling. Average drilling time in the last three years have been:

149 days per well in 1949
162 days per well in 1948
180 days per well in 1947

Drilling time is being reduced by the giant new rigs that are designed especially for deep drilling. The Gulf McElroy well in 1935 was drilled from a 136-ft derrick. Superior's Pacific Creek had a 192-ft derrick with a 37-ft square base and a 1,100,000-lb capacity. This extra height and greater power add to the efficient operation of the drilling crew.

Bits

The average number of rock and drag bits used shown in Table 1 gives an insight into formations. Mississippi uses the most drag bits per deep well whereas Wyoming uses none. New Mexico deep wells require an average 213 rock bits per well and Louisiana wells need an average of 41 rock and 16 drag bits.

Stronger alloys and diamond bits have had their effect on deep drilling as on all drilling but it is more important for deep footage. It makes a wide difference if a bit that must be sent down three miles for its work, can penetrate as much as 10 ft of an extra hard formation instead of perhaps 10 in. In 1935 the McElroy well used 718 bits (also 247 core heads), which gives some idea of the longer runs made possible today by improved bits when the average for all deep wells is 107 bits.

Mud

Drill mud has been one of the reasons for increased deep drilling. It has in some instances been the deciding factor in drilling and completing a deep well.

Dangerous pressures at great depths can be handled with heavy mud now where once the project would have had to be abandoned.

Heaving shale and lost circulation are not easy to combat at any depth and it is due in a large measure to chemical progress in making improved muds and to greater engineering skill in their use that these problems can be overcome in deep drilling.

In a number of cases deep wells have been able to leave record open hole with a plaster of mud for more economical drilling.

Mud costs in deep wells vary from a few thousand to $300,000 per well. Mississippi has the lowest mud costs; Texas has the highest.

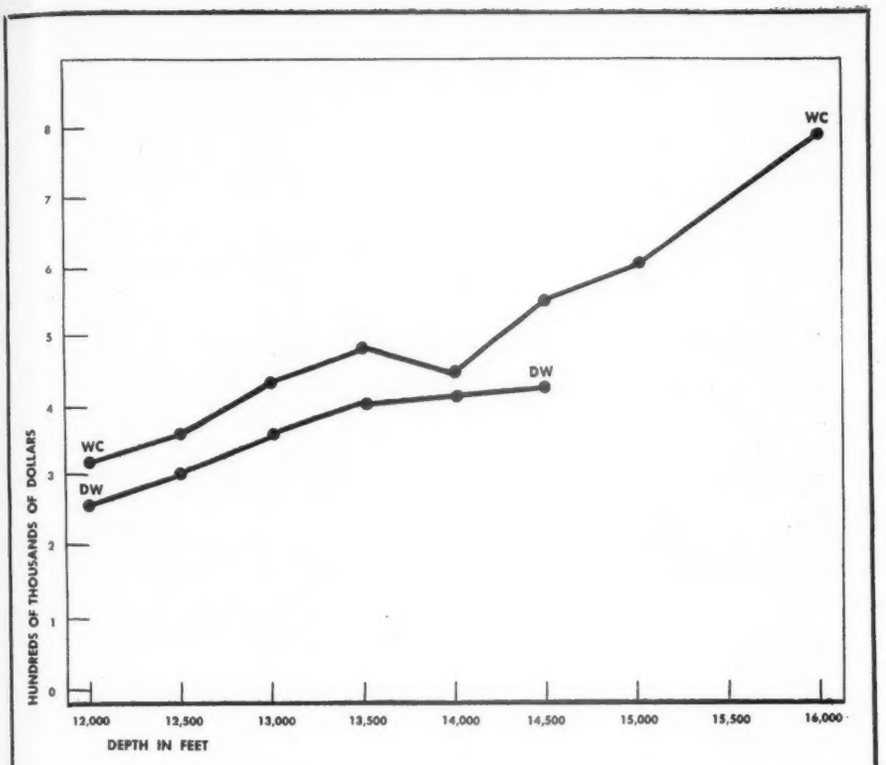
Deeper Footage, Higher Cost

The relation of price to depth has only in the last year or so formed a pattern. In the early years of the deep well survey the statistics did not indicate increased cost for deeper footage. There were not enough wells to overcome unusual cases. The total of 832 deep wells is sufficient to reveal the rise in cost that follows deeper footage (Fig. 2).

The cost of development wells is considerably lower than that of wildcats but follows almost the same upward curve compared to depth.

TABLE 7. Cost and cost factors.

	Total wells	Cost per well	Cost per ft	Average Depth	DT	Bits	Mud
Wyoming	17	$567,000	$42.08	13,475	353	208	$41,000
Oklahoma	26	475,000	34.09	13,288	341	196	33,000
Texas	163	420,000	32.64	12,898	221	128	62,000
Florida	19	382,000	29.43	12,981	271	68	20,000
California	156	376,000	28.51	13,186	210	189	15,000
New Mexico	21	326,000	25.86	12,606	209	213	18,000
Mississippi	16	301,000	23.19	12,980	179	103	14,000
Louisiana	418	288,000	22.62	12,730	118	55	25,000



A wildcat doubles in cost between 12,000 ft and 15,000 ft. Development wells cost less and do not have as sharp rise with depth. There were not enough development wells below 14,500 ft to obtain average costs.

Deep Holes Outside U.S.

Deep drilling has been strictly limited in countries other than the United States. Of the 20 tests that went below 12,000 ft only one appears to be successful. The Canadian Gulf No. 1 Walter Marr in the Pincher Creek field, Calgary, Canada, found gas and condensate production at 12,768 ft. A total of 8 deep holes have been drilled in Canada.

The old German Holstein No. 4 was the first deep well outside the U. S. It was drilled to 12,726 ft in 1938. Recently Shell-Jersey Standard drilled a second deep hole in Germany.

France has two tests below 13,000 ft. One was completed in 1947 and the other is still being drilled by Societe Nationale des Petroles d'Aquitaine.

In Venezuela Caribbean Petroleum Company has drilled two deep wells, one of which has the record depth for countries outside the U. S. This is the Curacao No. 2 A in Zulia province with a total depth of 15,106 ft. In Ecuador International Ecuadorian Oil Company drilled one deep hole.

Bahamas Oil Company (Superior) in 1947 reached 14,585 ft in a test on Andros Island, the Bahamas.

Papua in New Guinea Island had a 12,621-ft test in 1948, and the Lakhra test in Pakistan is below 12,666 ft.

From Russia there have been reports of two wells in the Baku region that have gone below 12,000 ft. One of them, completed in 1946, was said to have reached 12,806 ft.

Costs on deep wells outside the U. S. cannot be stated with definite accuracy because we have actual figures on very few. Canadian wells are drilled for about the same sums required in Wyoming. Burmah Oil Company is said to have expended one million pounds sterling already on the Lakhra test, which is not completed.

We "Dood" It

Almost 15 years ago K. C. Heald of Gulf Oil Corporation wrote a paper on deep drilling* stating the need to drill even deeper in order to increase production and reviewing the problems to be considered and how they could be met. His appraisal of the situation has been proved accurate by the data collected from that time to the present. The demand for greater supplies of oil and gas has brought deeper and deeper drilling, the problems of weight on a deep bit, fluid circulation, heaving shale, high temperatures, and blowouts have grown in degree as the bit went down. But the problems have been overcome and as Heald predicted "courage and ingenuity and science have . . . steadily increased the depth limits of safe and easy drilling."

What has been learned about deep drilling is especially valuable in the development of the tidelands. Because of experience in deep drilling, crews could take on over-water deep drilling with greater safety and more assurance of successful completion. When you think of the difficulties of tidelands drilling it is surprising to learn that 11 deep wells were drilled in the open Gulf of Mexico in 1949. Without the 15 years experience in deep drilling this feat would be virtually impossible.

*"Deep Well Drilling Problems and Their Solution", by K. C. Heald, presented at API Spring Meeting, June 4-5, 1936, Pittsburgh, Pennsylvania.

Conclusion

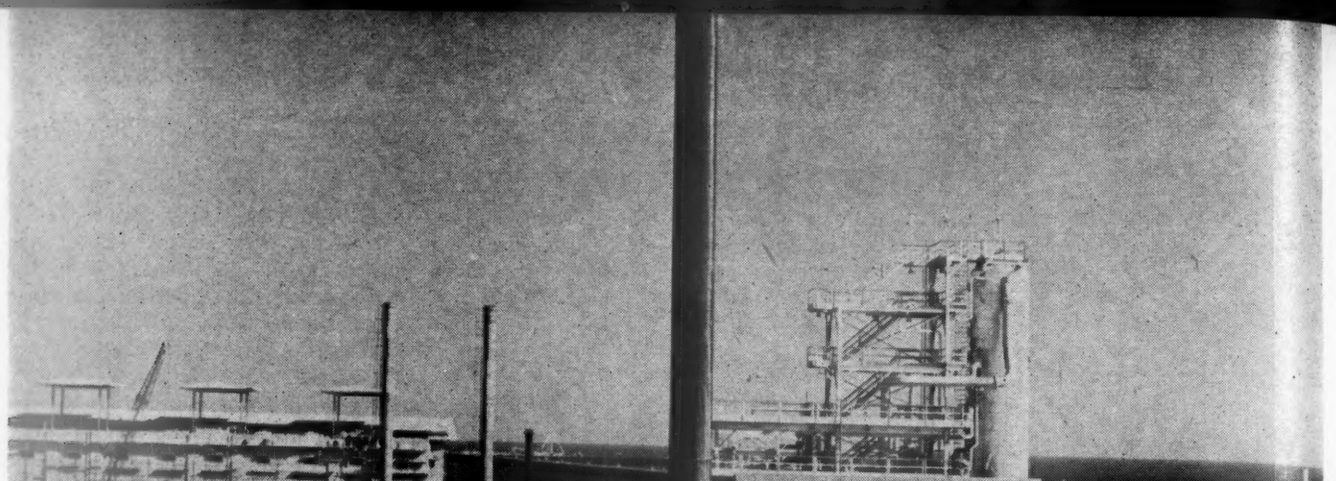
We have proved we can drill deep but have we proved it pays? That will depend principally on the price of oil and gas and the cost of drilling. To determine what will be the outcome is not easy. In the paper mentioned above Heald recalls that many believed the Wilcox sand in the Oklahoma City field was so deep that any oil recovered would not equal drilling costs. It took actual drilling to prove the theory false.

In the history of deep drilling for 15 years we can prove only that deep oil and gas costs more to find. When demand keeps the price of oil at a level to permit deep drilling, we will have deep holes aplenty. The interest in depths in recent years is due to the full determination of the oil industry to leave no area unexplored that might increase our reserves. The shaky world situation has to some extent, made cost a secondary consideration.

Considering all deep operations as one, the industry has fared well from its deep drilling investment. Cumulative oil and gas production from below 12,000 ft has more than paid for all deep drilling. The discoveries above that depth have made the investment much more attractive.

It is not now possible to collect the figures for costs for other drilling depths but most people will agree that profits for the industry as a whole has not caught up with its investment if we do not include reserves. All the more remarkable, then, that in this expensive segment of the industry for which figures have been gathered, the books are well balanced and definitely on the black side of the ledger.

This has resulted from the fact that activity is mostly in the last six years when demand was high, price was equitable, and the industry could afford the cost of drilling. The future of deep drilling leans upon the same factors. * * *



General view of the oil port of Mena Al Ahmadi showing the topping plant (right foreground), the main power station (left foreground) and jetty and oil loading pier (background).

P 100.

KUWAIT OIL PROGRESS

The richest known area in the world has an 1100-ft producing zone and an estimated reserve of 11 billion barrels of oil.

V. S. SWAMINATHAN

A 75-YEAR concession covering the entire Sheikhdom of Kuwait, with an area of approximately 6000 square miles, was granted by H.H. Sir Ahmad-al-Jabir-as-Subah in 1934 to the Kuwait Oil Company, jointly owned by the Gulf Oil and Anglo-Iranian. This company carried out geophysical surveys and gravity, magnetic and seismic observations in areas of potential interest. The first test well was drilled to 8000 ft at Bahra on the north of the Kuwait Bay. No oil being found here, prospecting operations were transferred farther to the south. Another wildcat was drilled on the flat Burgan anticline 30 miles south of Kuwait town. In February 1938 this well penetrated Cretaceous oil sands at 3672 ft and started flowing. Eight other wells were drilled in the next 4 years, varying in depth from 3800 to 4000 ft and covering an area of 5 miles square. Rapid Axis advances made it advisable to suspend work in 1942 and to plug the wells with cement. Operations were resumed in 1944, the company reconditioning the wells as dual zone producers. This was done by perforating the casing at two of the oil bearing sand horizons. Burgan is now known to be the world's largest individual oil field. The shallowest production is at 3600 ft and the deepest at less than 5000 ft. At the center of the structure the producing zones are 1100 ft thick. De Golyer and MacNaughton ("Twentieth Century Petroleum Statistics", 1949 Edition) credit Kuwait with 11 billion barrels of proved reserves.

Production now comes from three major sand horizons between 3500 and 4800 ft. They are Middle Cretaceous in age and domal. The capacity of the company's producing wells, which

EXCLUSIVE

Data on Kuwait Field

	1948	1949
Number completed wells Dec. 31	37	86
Number producing wells Dec. 31	31	61
Number observation wells Dec. 31	1	2
Daily average production (bbl)	126,357	246,752
Daily average production (tons)	17,190	33,425
Total production for year (bbl)	46,546,795	89,930,444
Total production for year (tons)	6,291,577	12,183,669

numbered 86 by the end of 1949, is deemed sufficient to meet present requirements and the drilling program is therefore being curtailed. A deep test well is at present being drilled to explore for deeper horizons. Recent data are given at right.

Pipe Line Data: Transit lines from Burgan to Ahmadi—One 20-in. by 10 miles long completed in 1948; one 20 in. by 10 miles long completed in 1949.

Gravity lines from Ahmadi to Mena al Ahmadi—One 22-in. by 6¼ miles long completed in 1946; one 22-in. by 6¼ miles long completed in 1948; three 24 in. by 6¼ miles long completed in 1949.

Refinery Data: Refinery commissioned November 14, 1949, has capacity 25,000 bbl per day throughput. Total throughput in 1949 was 877,402 bbl.

Kuwait oil is paraffinic - asphaltic mixed base crude possessing these properties:

Sp. gr. at 60°/60°F.	0.866
Viscosity, Redwood at 100°F., sec.	52
S per cent wt.	2.4
R.v.p. at 100°F.	10.1
Pour point, °F.	0
Asphaltenes, per cent wt.	1.0
Distillation A.S.T.M.:—	
I.b.p., °C.	38
5 per cent Vol. rec. at °C.	84
10 per cent Vol. rec. at °C.	117
20 per cent Vol. rec. at °C.	173
30 per cent Vol. rec. at °C.	230
40 per cent Vol. rec. at °C.	287
Vol. recovered at 300°F., per cent	43
Vol. residue per cent	56
Vol. loss per cent	1.0

Two gathering centers were commissioned during 1949, each with a capacity of approximately 100,000 bbl per day.

Separators

Seven-stage separation is employed using horizontal separators. The Burgan field is divided into a number of producing areas of nearly 16 square miles each, with 16 to 20 wells in each area, the present well-spacing plan being one well for each 600 acres. The gathering focus is situated in the center of each producing area. The gas and oil separators used are shells of 4 ft 6 in. in diameter, and are in flanged sections 25 ft long with eccentric conical ends, their overall length being approximately 144 ft for each separator. Gathering centers have been designed for an initial separation pressure of 425 psi.

The number of stages of separation is based on the successful Anglo-Iranian company's practice in Persia over a period of years. The multi-stage system takes advantage of the natural gas laws for retaining the greatest proportion of usable hydrocarbons in a liquid form. This results in a greater volume of oil recovered from the same quantity of well effluent, and in a slight improvement in gravity. There is approximately 1.6 per cent additional liquid recovery for seven over three stages of separation, or 1600 bbl per day on the basis of the maximum separating capacity of each gathering center of 100,000 bbl per day, with an increase in API gravity of 0.5. The most interesting feature of the gathering centers is use of orifice meters for allocating oil and gas to individual wells. These are located on the well flow lines immediately ahead of the 425 psi separators and measure the combined flow of oil and gas from each well. The daily production as indicated by tank gauges and master gas meters is allocated to the wells on the basis of factors derived from the line meters.

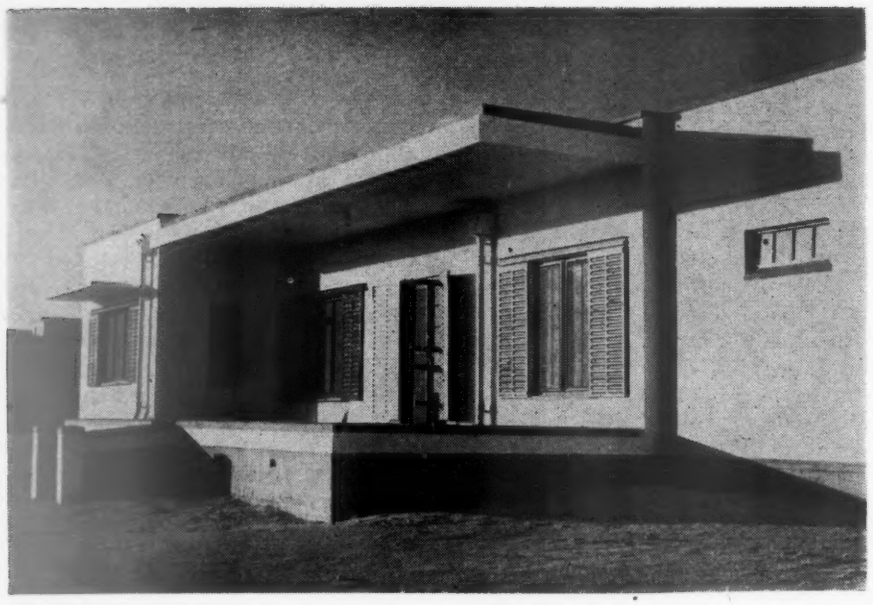
Refining Capacity

Commencing construction late in 1948 the Kuwait refinery came on stream in mid-November 1949. The plant consists of a 25,000 bbl per day topping unit, to which is added a small refractionator and doctor-sweetening plant capable of treating motor gasoline and kerosine and gas oil to meet the needs of the company in its operations together with the local market demands of the Sheikhdom of Kuwait, as well as to produce sufficient furnace oil and marine diesel oil bunkers to supply tankers loading Kuwait crude at the Mena al Ahmadi oil terminal.

The topping unit comprises an automatic temperature-controlled forced-draught two - pass furnace heater equipped with dual purpose gas/oil burners; a 13-plate topping tower with a 5-plate reduced area stripping section; a combined external kerosine and oil stripper with 5 trays in each section; a 20-tray gasoline refractionating tower; a ring - packed benzine stripping tower, together with the necessary control instruments, pumphouses, etc.

The unit is operating to produce at 173 C main column overhead gasoline,

View of the oil loading pier head.



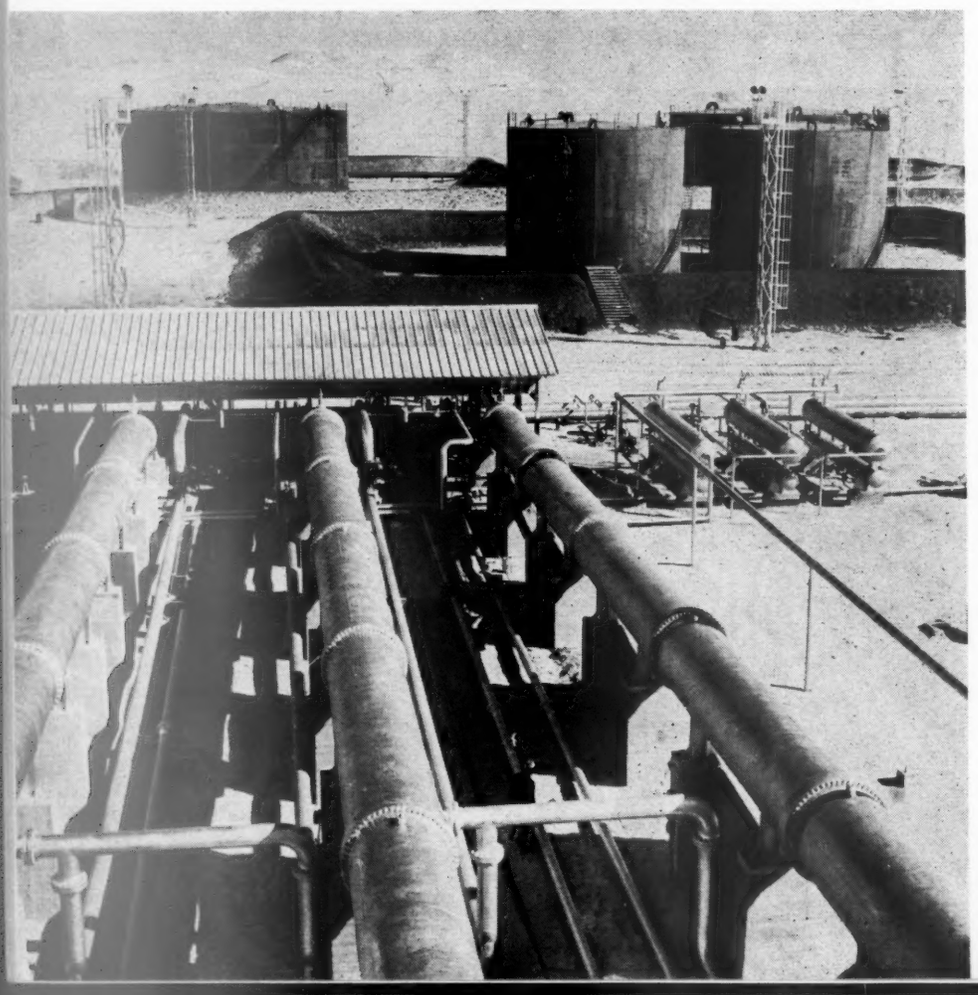
Housing for oil company employees.

a portion of which is passed to the refractionator, where a small amount of naphtha bottoms is removed, when the overhead from the refractionator is pumped to the stabilizer for the removal of undesirable light ends, resulting in a 150 C end point stabilized benzine. The balance of the main column overhead and the refractionator bottoms are passed to surplus products. Two side cuts are made of: (a) A kerosine of approximately 243 C end point and 133 C minimum flash and (b) a gas oil of approximately 345 C end point. Both are used for blending. The kerosine is also used to meet the local requirements. The residue is employed for blending with kerosine and gas oil to make marine diesel oil and bunker furnace oil, the proportion of each being adjusted to keep the sulfur content of the blended products within the specification limits, as well as maintaining the appropriate minimum flash figures.

The raw stabilized benzine is pumped to the plumbite treating plant which consists of two horizontally mounted batch washers employing the doctor-sweetening process and capable of dealing with up to approximately 500 bbl per day per washery. This treatment is followed by a TEL addition in normal batch eductor type blending insulation to bring the octane number rating up to 70 (MM). Only motor gasoline is subjected to treatment, though facilities are available for treating kerosine if needed.

Owing to shortage of fresh water in the Kuwait territory the utilization of steam is reduced to a minimum and, except for reserve fuel oil and blowndown pumps, the unit is an all-electric drive. The only continuous use of steam is that required for stripping. Likewise, maximum use is made of crude charge heat exchange against the hot reduced crude, which is also employed for bottoms reboiling on the gasoline refractionator and coil heating at the base of the stabilizer. Cooling water for overhead condensers and the kerosine and gas oil coolers is taken from the Persian Gulf and returned thereto without the use of cooling pond or towers. Arrangements are under way for shock chlorine treatment of the cooling water to eliminate marine growth in the overhead condensers, pipework, etc.

Separators at one of the gathering centers.



Tank Farm

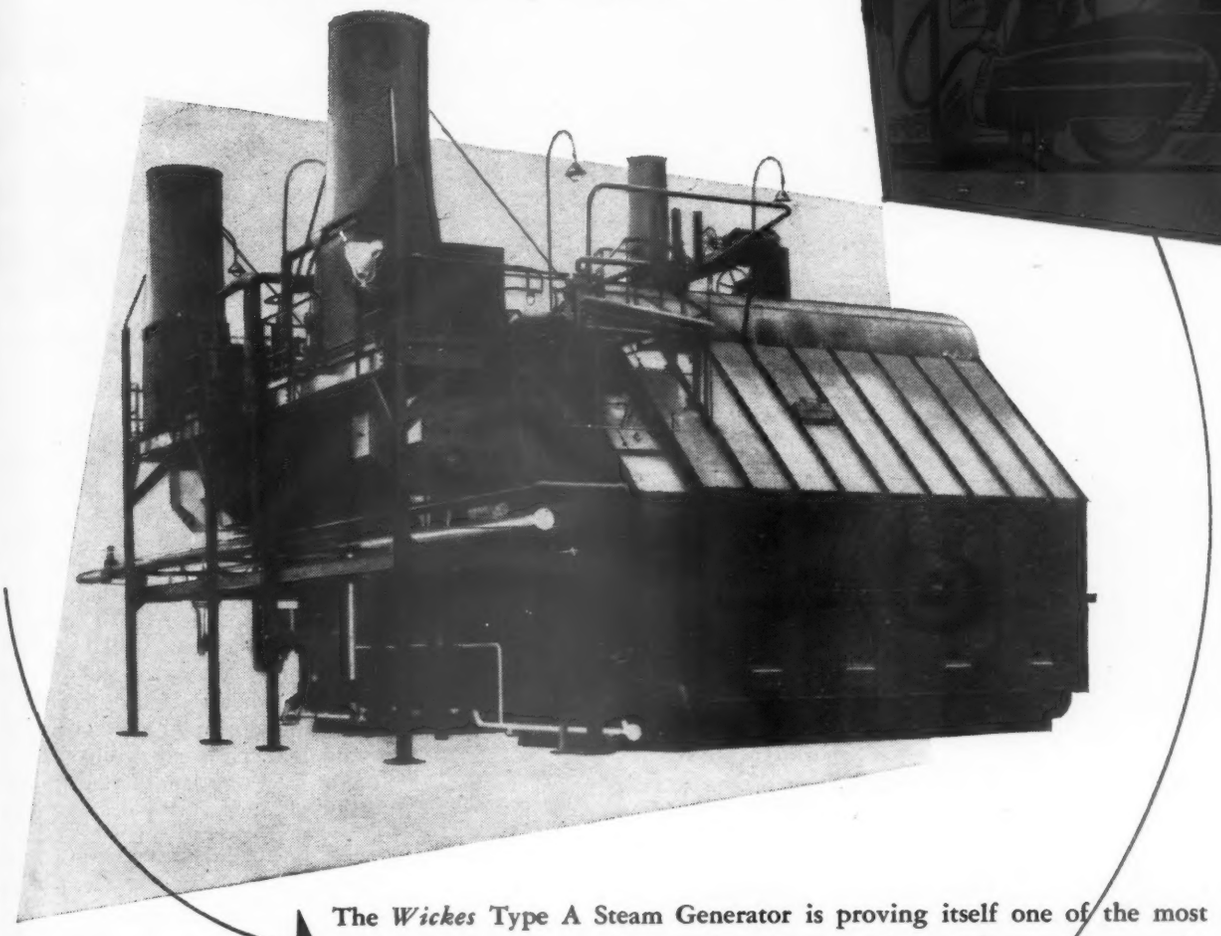
Crude oil is pumped from the gathering centers at Burgan via 20-in. transit lines to the main tank farm at Ahmadi, which had a storage capacity at the end of 1949 of six 139,000-bbl tanks and nine 168,000-bbl tanks with a further six 168,000-blb tanks being built. The tank farm is situated at an elevation of about 420 ft above sea level and oil gravitated from the storage tanks through the gravity lines to the terminal oil jetty at Mena al Ahmadi. Here three 168,000-bbl tanks were constructed in 1949, of which two are for the storage of distillate and furnace oil and the third for crude oil for operation in conjunction with the loading pumphouse.

Loading Pier

The Kuwait Oil Company's oil loading pier—the largest of its type in the

WICKES STEAM GENERATORS

at work in new Texas natural gasoline plant...



The *Wickes* Type A Steam Generator is proving itself one of the most serviceable boiler units employed by the oil and gas industry. These units, recently installed at a new Texas plant, each generate 80,000 pounds of steam per hour. The efficiency and ease of installation make the Type A boiler especially suited to the industry. *Wickes* can fill your exact requirements for boilers of any type up to 250,000 lbs. steam per hour and 850 p.s.i.

Wickes service facilities are world-wide and our knowledge of steam generation is available to you without obligation. Write for descriptive literature on the famous *Wickes* line of steam generators.

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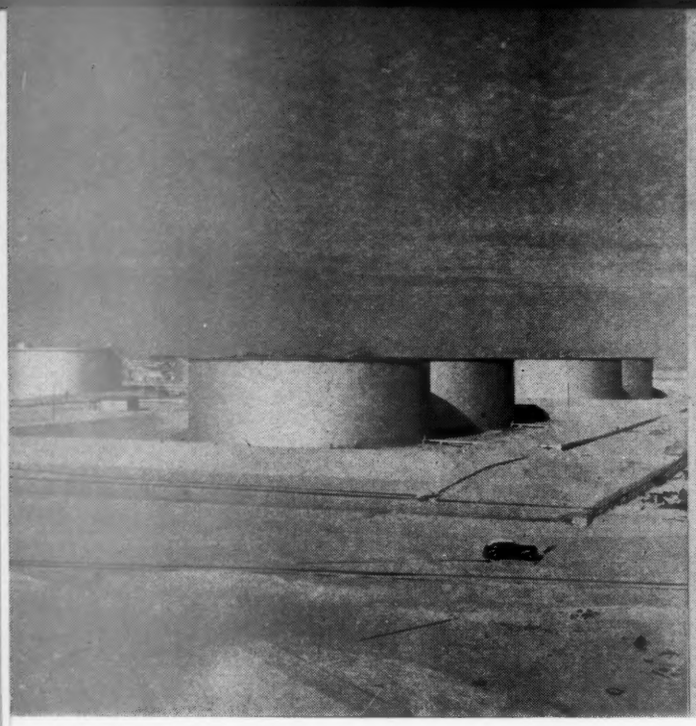


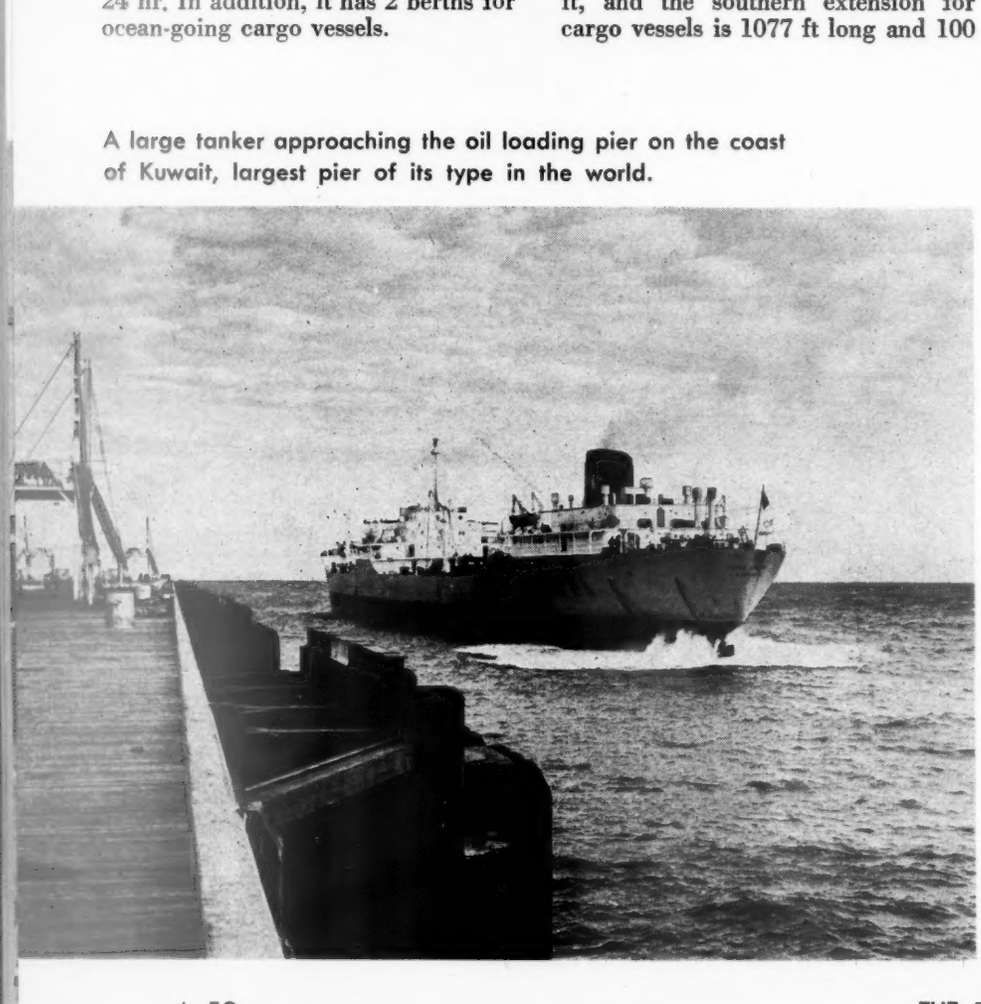
General view of the tank farm at Ahmadi.

Oil feed lines and approach pier.

world — was completed late in 1949. Built at Mena al Ahmadi, the nearest point on the coast of Kuwait to the company's new town of Ahmadi, it is large enough to berth 6 tankers at once and to load them with crude oil at a rate of over 70,000 tons every 24 hr. In addition, it has 2 berths for ocean-going cargo vessels.

The approach trestle, carrying the pipeway and the 24-ft roadway, is 4140 ft long and 49 ft 6 in. wide. At its head extensions to the north and south form the oil loading and cargo berths. The northern extension has a length of 2805 ft and a width of 105 ft, and the southern extension for cargo vessels is 1077 ft long and 100 ft wide. The main structure of the pier consists of 3851 steel piles—14-in. H-beams weighing 73 lb a foot and averaging 90 ft in length—each of which was coated with hot coal-tar enamel before being driven into the sea bed. There are in addition 65,300 assorted pieces of structural steel, all with welded joints. There are more than two million board feet of timber in the decking alone and another million in fenders, curbs, and railings. Every piece of steel was sandblasted, coated, or painted, and every piece of timber was given preservative treatment.

A large tanker approaching the oil loading pier on the coast of Kuwait, largest pier of its type in the world.



The superstructure includes two office buildings, a compressor and storage building, several fire-protection pumping stations, 6 double stiff-leg hose-handling derricks, four 6-ton portal cranes and a 60-ton stiff-leg derrick. The pipeway carries eight 24-in. crude oil lines, one 16-in. line for bunker fuel oil and one 12-in. diesel-fuel line. Besides these there are several smaller lines for fresh water, salt water, and compressed air. Together these lines make it possible to load 6 tankers simultaneously with crude oil, to supply them with fuel and fresh water, to provide a temporary supply of sea water to the adjoining refinery and to afford fire protection. The pipe lines are anchored at the shore end by a large concrete block and are carried on rollers to the pier head where movement caused by contraction and expansion is permitted at an S-bend. That ample allowance must be made for such movement is apparent from local meteorological records. A maximum of 170 F (in the sun) in summer, and 30 F in winter is not abnormal.

Protection for Loading

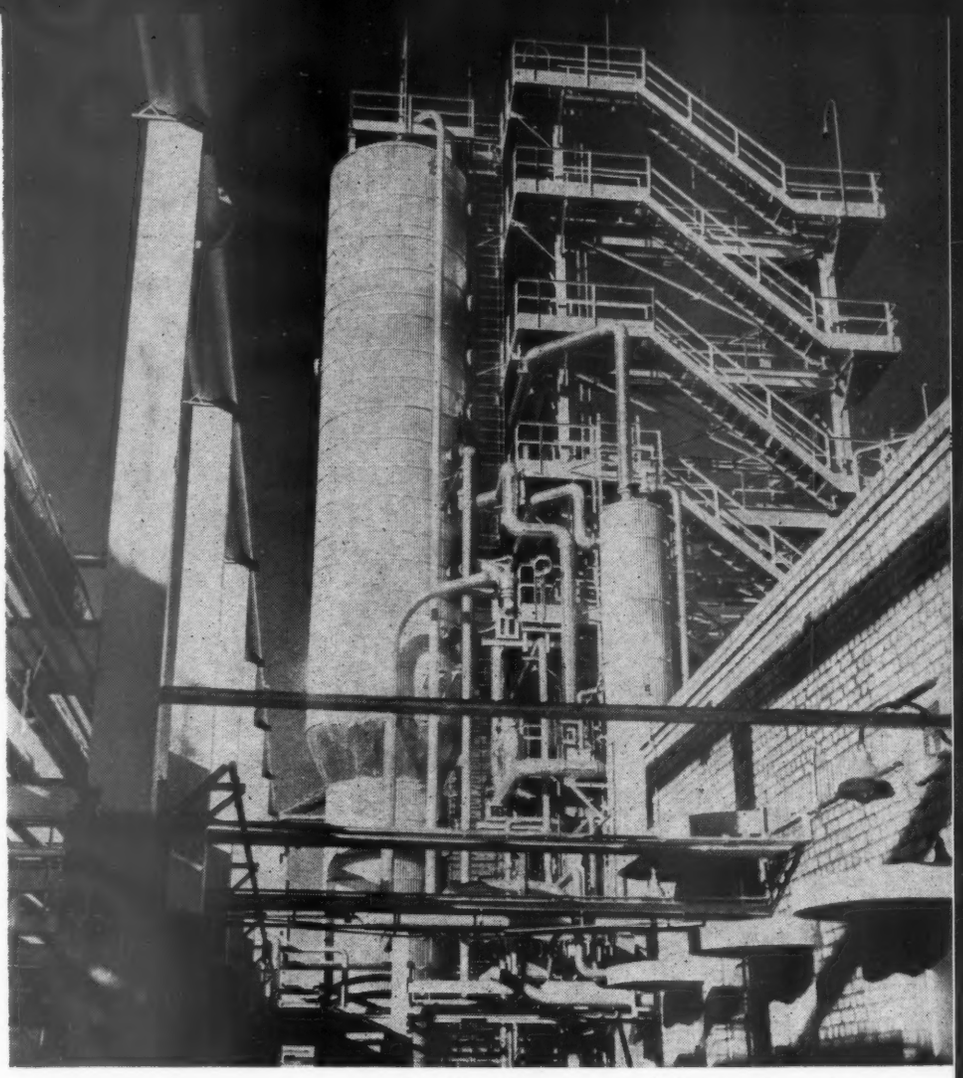
Of special interest are the gravity fenders, with which the oil and cargo piers are fitted. Since the coastline affords no protection against bad weather, it was necessary to devise means to safeguard both the pier and the ships using it from damage in high seas. The company decided to use a type of suspended fender invented by Professor A. L. L. Baker of the Imperial College of Science, London, adapted for the conditions obtaining at Kuwait. First installed on a jetty at Heysham, England, during World War II, the fenders were adapted for "Mulberry" harbors to enable LSTs to berth at a speed of 4 knots without damage. The fender in use at Kuwait consists of three cylinders, each measuring 6 ft in diameter and 21 ft 3 in. in height, filled with concrete and weighing 50 tons. It was estimated that a set of three such cylinders together, suspended at the top and bottom on links between trunnions, could cushion and resist a pressure of 250 tons by swinging inward and upward on the impact of a vessel. Faced by 14-ft timbers, the sets of cylinders are spaced at intervals of 135 to 165 ft. There are 44 sets in all.

Corrosion System

Corrosion is a serious problem in the waters of the Persian Gulf and to supplement the coal-tar enamel protection against this ever-present menace, a cathodic system has been installed. A huge wet cell was created by immersing magnesium anodes in the sea water alongside the steel piles, these becoming cathodes when connected through a current-limiting resister. The current breaks up the electrolyte (the sea water) so that hydrogen ions are deposited on the steel to form a corrosion-resistant film. The magnesium anodes are gradually eaten away while the steel remains intact.

Rapid Loading Permitted

The entire pier, composed of nearly 38,000 tons of materials, is designed and engineered for maximum safety and longevity, and was completed in just under 18 months. In the short time the pier had been in use its loading capacity has more than fulfilled expectations. One of the world's largest tankers was recently loaded with 26,303 tons of oil in 7 hr 14 min. This jetty, with a designed loading capacity of 500,000 bbl per day, supersedes the original 5 submarine line-loading berths. It permits more rapid loading and ship turn-round and reduces delays due to bad weather. For the protection of craft required for the operation of an oil port, such as tugs and mooring launches, a harbor has been built immediately to the south of the pier.



Fractionating tower of the topping plant.

In 1947 Shell Petroleum entered into a contract with Gulf Oil to purchase annually increasing volumes of Kuwait crude over a period of years. In 1949 it absorbed about 32,000,000 bbl under this arrangement. From Kuwait Anglo-Iranian obtained 5,625,000 long tons of oil as its share during the same period.

Living Conditions

The permanent housing program made good progress in 1949. In all 345 permanent houses for staff and labor have been built and 107 prefabricated houses erected. In addition, 1949 saw the opening of a staff guest house and restaurant, which also contains a number of bachelor flats. The construction of the company's main office and the dispensary at Ahmadi are nearing completion. Work on a further block of bachelor flats and one of the staff clubs is well advanced. With the main constructional program almost over the total number of employees has decreased considerably, and living conditions and recreational facilities have been further improved.

The company's hospital at Magwa now has 120 beds, is fully air-conditioned, and possesses equipment to insure the most modern forms of treatment. Its medical staff includes specialists in surgery, medicine, bacteriology, pathology, and gynaecology, assisted by radiographers, physiotherapists, and a matron and nursing sisters trained in British hospitals. A section of the hospital also provides a clinic for dental surgery. A sanitary department under the supervision of the Chief Medical Officer is responsible for all sanitary and pest control.

A technical training center is now functioning, for training Arabs in selected trades. The company runs two primary schools, one for the children of British and American employees and the other for those of Indian and Pakistani workers. Recreational facilities embrace a variety of sports, including football, cricket, hockey, golf, swimming, tennis, yachting, fishing, and squash racquets. Recreational rooms, cinemas, and clubs are provided by the company. * * *

PETROLEUM PROFILE

Ralph B. McLaughlin
President,
The Texas Pipe Line
Company

RALPH B. MCLAUGHLIN, president of The Texas Pipe Line Company, is a native of Fredonia, Pennsylvania. He received his early education in Pennsylvania and later completed an International Correspondence School course and other courses in special subjects.

He entered the employ of The Texas Company at Sour Lake, Texas, on June 6, 1906. After a series of promotions, he was appointed auditor of disbursements of The Texas Company, Pipe Line Department.

In 1917, The Texas Pipe Line Company was organized and immediately acquired the pipe line property of The Texas Company. McLaughlin was elected assistant secretary of The Texas Company and on March 24, 1924, was elected secretary and assistant treasurer. On March 7, 1936, he was made secretary and treasurer. He later was elected vice president and assistant manager of The Texas Pipe Line Company and Texas-New Mexico Pipe Line Company. He also was made vice president and manager of The Texas Pipe Line Company and Texas-New Mexico Pipe Line Company, as well as vice president of the Texas-Empire Pipe Line Company and Kaw Pipe Line Company.

From 1920 to 1940, he served as a member of the API special committee on Interstate Commerce Commission Depreciation Study and Pipe Line Regulations. He was admitted to practice before the ICC in 1937.

In 1934, he was elected as chairman of the API Engineers-Accountants Sub-Committee to represent the carriers by pipe line before the valuation section of the ICC. He was named a member of the API Valuation Committee in 1940.

In March 1942, he was appointed associate director of the Transportation Division of the Administration for War, with headquarters in Washington, to prepare a program of transportation facilities, which included the 24-in. line from the Texas Gulf Coast area to the Atlantic seaboard.

He became president and general manager of The Texas Pipe Line Company March 8, 1947. McLaughlin also is president of Texas-New Mexico Pipe Line Company, Texas-Empire Pipe Line Company, and Kaw Pipe Line Company.

Deep Drilling in West Texas

ALTHOUGH the 12,000-ft Benedum field of Upton and Reagan counties probably won't produce the tremendous quantities of oil that were forecast by some people soon after its discovery in December, 1947, its discovery and development marked an upturn in the drilling of deeper exploratory wells in the Midland Basin. Most operators now project many of their wildcat or outpost wells to test the Ellenburger or some younger formation that may yield production between 10,000 and 14,000 ft from the surface. Much of the drilling equipment in West Texas is now capable of reaching such depths, and important oil and gas production has been established in many of the formations that such deep wells would penetrate. Failure to test adequately all the potential producing formations to such depths might result in the abandonment of acreage that a more enterprising operator would find productive.

More than 50 exploratory wells between 10,000 and 14,000 ft deep were drilled last year in West Texas in this competitive effort to explore all possible producing formations within ordinary drilling depth limits. This led to the discovery of oil or gas in some 22 wells, which opened new pools or extended old ones. The search for such deep pools is very expensive. As much as $1,000,000 per well has been spent on some of these deep wells before all the formations were drilled, cored, and tested adequately. The successful completion of more than 35 per cent of these exploratory wells, however, is a tribute to the foresight, thoroughness, and persistence of those who have financed and directed the explorations.

The search for new pools in the deep formations of West Texas has been stimulated by the recent discoveries in Terry and Hockley counties (see the article beginning on Page B-7) as well as those in Midland County and other areas. Hundreds of new deep wells will be drilled in the present deep pools and in prospective deep producing areas of West Texas during the next few years. The development will continue to be orderly, and thorough tests will be made of all prospective producing formations. The results so far indicate that deep drilling will open important new crude oil reserves; however, the costs are now high, and the risks are great.—K. M. F.

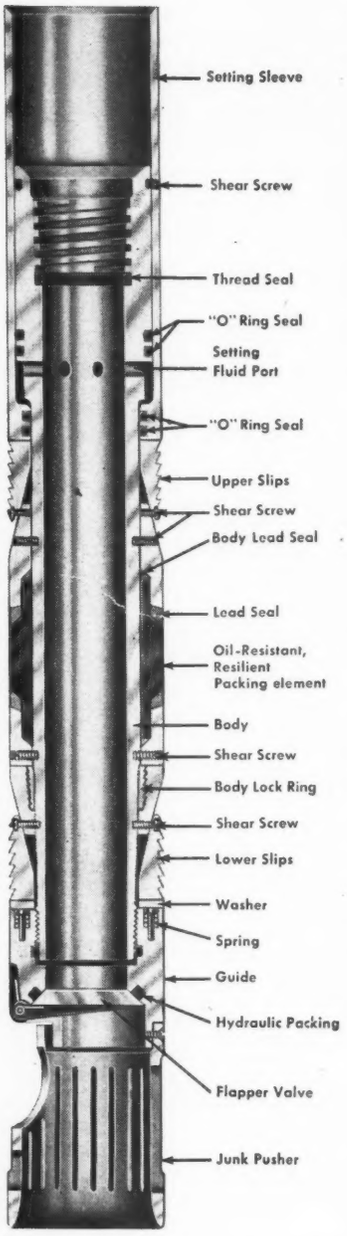
Get Better Results with this

Designated by an engineer-author as the "Universal Type," this packer not only takes care of the "every day" routine installations, but is adaptable to many applications previously considered either difficult or impossible.

The ability of this "Universal Type" Packer to cover such a wide range of applications is due fundamentally to the construction of the Packer itself. A Hycar packing element, retained by lead seals, is mounted between two sets of opposing slips so that the Packer virtually becomes a part of the casing; cannot be moved up or down the hole; and prevents fluid or gas from passing in either direction between the packing element and the casing. After the Packer has been set and the Setting Tool has been removed from the hole, only the smooth bore Packer (at right) is left in the well, securely packed-off, and ready for use of the proper Baker Packer Accessory Equipment to meet your specific well requirements.

Meets Varied Production Requirements

The Baker Model "D" Retainer Production Packer, with easily operated accessory equipment, has gained wide popularity because of its effective application to many needs in producing wells. It can be set and used for making a flow test, utilizing the Packer for production through the tubing if the zone proves productive. If not productive, the zone can be squeeze cemented through the Packer. A single Packer provides for production of two zones, either simultaneously with segregated production or from each zone separately at different times. For three-zone production only two packers are used.



Baker Model "D" Retainer Production Packer shown ready to run in the well, but prior to introduction of Setting Tool shown in Figure 1.

The Baker Retainer Production Packer is used for single-zone production to prevent gas from cutting holes in the casing (often started by thread leaks) by transferring the pressure from the casing to the tubing. If and when the tubing leaks, it can be pulled, repaired and replaced through the Packer. The Packer will protect the casing when corrosive fluid is being produced or injected, by permitting the annulus to be filled with oil and confining the corrosive action to the tubing only.

No Interference with Operations

While the Baker Retainer Production Packer virtually becomes a part of the casing and will not move up or down regardless of pressure from either direction, it still permits maximum flexibility of operations. When it becomes necessary to remove the tubing, the Flapper Valve in the lower end of the Packer closes to isolate the formation below, and later the tubing is readily replaced without disturbing the Packer. It is never necessary to pull rods or tubing under pressure.

Many Important Advantages

Let us consider the major advantages which make the Baker Model "B" Retainer Production Packer so economical, so easy and safe to run and operate . . . IT HOLDS BOTH WAYS – The Packer is anchored against either upward or downward movement by two full sets of opposing slips. This feature is always desirable, and is vital in gas-injection or water-injection wells where

Specify the Baker Model "D" Retainer Production Packer Product No. 415-D

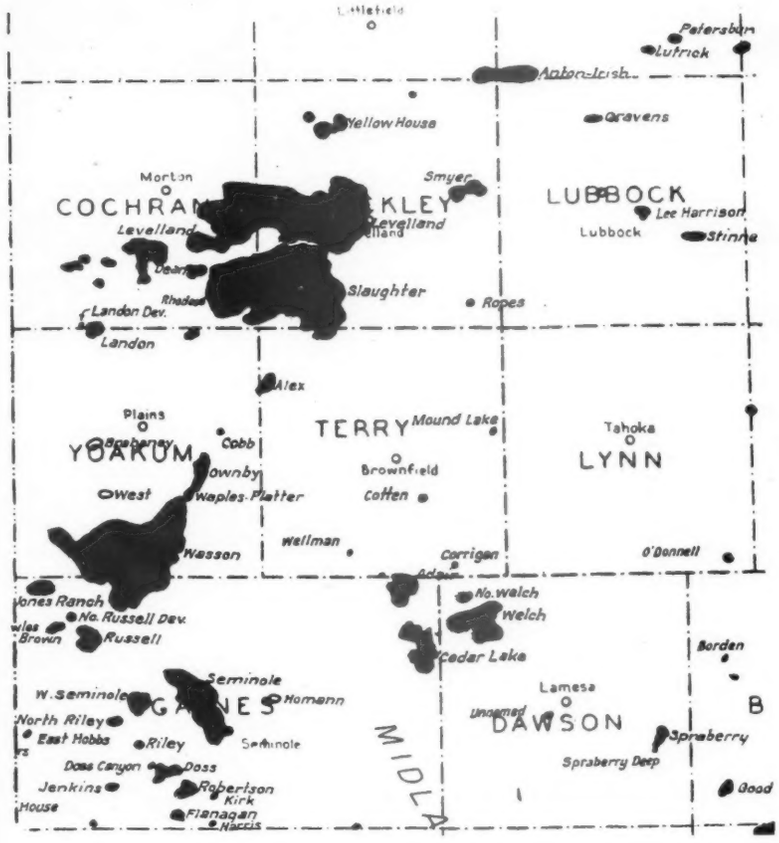


FIG. 1. An important Pennsylvanian reef trend is indicated by recent prolific discoveries from Wellman and Adair in South Terry County to Ropes in Southeast Hockley County. The Cotten field discovery well appears to be an important link in chain of new deep reef fields.

Deep Pennsylvanian Reef Discoveries Spur Exploration

K. MARSHALL FAGIN†

RECENT discovery of four deep Pennsylvanian reef oil fields, Ropes in Hockley County, and Wellman, Cotten, and Adair (deep) in Terry County, Texas, has given considerable impetus to new deep exploratory drilling in the north part of the Midland Basin. Although opinions vary greatly as to the probable size and importance of these new fields, more than a dozen wells are now being drilled in search of similar fields along the trend from Adair in southern Terry County to Ropes in southeastern Hockley County, or as extensions to the present fields. (See Fig. 1).

The discovery wells in the four new fields have been completed with high initial production rates, low gas-oil ratios, and free from water encroachment (see Table 1), which indicate considerably better reservoir conditions than found in Mound Lake, the first deep field discovered in the area last year. Wells in the new fields flow from 900 bbl per day on a ½-in. choke to 2280 bbl per day on a 1-in. tubing choke with gas-oil ratios ranging from 380 to 750 cu ft per bbl. The oil is 42 to 43 API gravity and sweet.

Development of these new deep reef reservoirs is not apt to be as rapid as the development of the Scurry County reef fields for several reasons. First, the wells are deeper (8600 to 10,200 ft) and about twice as expensive ($150,000 vs $75,000) as the 6800-ft Scurry County Canyon reef wells. Second, the reef reservoirs discovered so far are not as thick as the Scurry reef reservoirs. The Wellman field reef, however, indicates a total thickness of some 400 ft in Magnolia's Scales No. 1, the east offset to the discovery well. Third, it takes about twice as long to drill and test the wells in this area as in Scurry County. Nevertheless, drilling activity in this area is increasing as the present wells are extended and new ones are found, and it is quite possible that this activity may approach the Scurry County pace should several of the present outpost wells indicate a continuation of reef production.

Age of the Reefs

Although geologists have not agreed on the age of the reef limestone reservoirs in Terry and Hockley counties, they are identified as Upper Pennsylvanian or Lower Wolfcamp (Permian) age. The reefs in Wellman and Adair are reported to be of Wolfcamp age, Lower Permian fossils having been identified in the cuttings and cores. The reefs in Cotten and Ropes

TABLE 1. Discovery well data on deep Pennsylvanian reef fields in Terry and Hockley Counties, Texas.

Field → / County →	ROPES, Hockley	MOUND LAKE, Terry	COTTEN, Terry	WELLMAN, Terry	ADAIR, Terry
Discovery well name	Honolulu & Signal #1-13 M. D. Underwood	Seaboard Oil Co., #1 E. M. Hinson	Union Calif., #1 Laura A. Cotten	Anderson-Pritchard, #1 H. C. Bevers	Amerada Pet. Corp., #2 N. W. Willard
Completion Date	May 21, 1950	Mar. 10, 1949	Sept. 1, 1950	July 12, 1950	Sept. 23, 1950
Initial production, bbl	2236	150 (& 20 water)	1812	2280	912
Surface choke, in.	1"	pump	5/8"	1"	½"
Gravity of oil, deg. API	42	43	44	43	43
Gas-Oil ratio, cu ft/bbl	386	450	746	470	456
Elevation, ft.	3389	3264	3262	3277	3226
Total depth, ft.	9325	11,845 (Ellen.)	10,182	9811	8610
Plugged back depth, ft.		9433	10,150	9805	8563
Depth to top of reef, ft.	9285	9398	9902	9705	8505
Depth to water in reef, ft.	below 9325	9485	below 10,123	below 9811	8606
Oil-water contact, subsea ft.	below —5936	—6221	below —6861	below —6534	—5380
Reef thickness above water, ft.	more than 40	87	more than 221	more than 106	100
Production section, ft.	9290-9325	9398-9485	9998-10,073	9712-9805	8500-8560
No. of perforations	open hole	open hole	300	328	240

†Editor, Drilling and Producing.

EXCLUSIVE

TABLE 2. An analysis of a daily drilling log on an 8600-ft reef well in Terry County, Texas.

Day No.	Remarks	Depth	No. ft drilled	Drilling time, hr	No. of trips	Trip time, hr	Bit No.	Bit time hr	Bit No.	Bit time, hr	Hole Dev., deg.	Drilling mud wt.	vis.	W.L.	Cake
1	Staked location	0													
2	Building roads	0													
3	Building derrick	0													
4	Moving in tools	0													
5	Moving in tools	0													
6	Completing 168 ft water well	0													
7	Cased water well	0													
8	Completed derrick	0													
9	Digging pits & rigging up	0													
10	Digging pits & rigging up	0													
11	Began drilling 17½" hole	75	75	2.50			1	2.50				(natural)			
12	Ran 13⅜" casing—350 sx cement	321	246	14.25	1	1.0	1	16.75				(natural)			
13	W.O.C. 20 hr—then drilled plug	551	230	4.00			2	4.00				(natural)			
14	Drilled 12¼" hole to 1215 ft	1800	1249	20.50	2	2.5	2	14.00	3	6.50	½	(natural)			
15	Drilling 11" hole, Anhydrite & Gyp	2190	390	14.50	3, 4	5.5	4	14.50			½	(natural)			
16	Drilling 11" hole, Anhydrite & Salt	2860	670	20.25	5	2.8	5	20.25			½	(natural)			
17	Drilling 11" hole, Anhydrite & Gyp	3217	357	20.75	6	2.5	6	13.75			½	(natural)			
18	Drilling, reaming, running elec. log	3230	13	3.00	7, 8	8.0	7	10.00	½		½	10.9	36		
19	Mixing mud & conditioning hole	3230	0		9, 10	10.0						11.0	43		
20	Running 8⅝" with 4 centralizers from 3215 to 3084 ft. Set at 3227 ft with 1500 sx 3% gel cement—W.O.C. 14½ hrs														
21	Picking up 3½" drill pipe; Connecting up 8⅝" casing; Running temperature survey														
22	Tested casing (1200 psi), drilled plug	3597	367	14.25	11	3.0	8	14.25			½				
23	Drilling 7⅞" hole, Anhydrite	3967	370	17.00	12, 13	5.0	9	8.00	10	9.00	½				
24	Drilling 7⅞" hole, Anhydrite & Gyp	4090	123	8.00	14, 15	11.5	11	4.00	12	4.00					
25	Drilling 7⅞" hole, Anhydrite & Gyp	4158	68	10.75	16, 17	10.5	13	5.00	14	5.75	½				
26	Drilling 7⅞" hole, Anhydrite & Lime	4405	247	16.00	18, 19	8.0	15	8.00	16	8.00	¼				
27	Drilling 7⅞" hole, Limestone	4570	165	15.25	20, 21	8.0	17	8.00	18	7.25	¼				
28	Drilling 7⅞" hole, Limestone	4615	45	9.50	22, 23	9.5	19	5.00	20	4.50					
29	Drilling 7⅞" hole, Limestone	4768	153	15.25	24, 25	7.0	21	7.25	22	8.00					
30	Drilling 7⅞" hole, Limestone	4950	182	17.25	26, 27	6.5	23	8.50	24	8.75	½				
31	Drilling 7⅞" hole, Limestone	5421	471	16.00	28, 29	7.3	25	8.00	26	8.00	¾	10.1	31		
32	Drilling 7⅞" hole, Limestone	5788	367	15.75	30, 31	7.3	27	8.00	28	7.75	1	9.9	30		
33	Drilling 7⅞" hole, Limestone	5992	204	11.00	32, 33	6.3	29	5.00	30	6.00	1¼	9.9	30		
34	Drilling 7⅞" hole, Limestone	6265	273	14.25	34, 35	7.8	31	7.00	32	7.25	1½	9.9	31		
35	Drilling 7⅞" hole, Limestone	6385	120	9.00	36, 37	6.0	33	4.00	34	5.00	1	9.9	31		
36	Drilling 7⅞" hole, Limestone	6510	125	14.75	38, 39	7.8	35	7.00	36	7.25	¾	9.8	30		
37	Drilling 7⅞" hole, Limestone	6596	86	10.25	40, 41	8.5	37	4.00	38	6.25		10.0	31		
38	Drilling 7⅞" hole, Limestone	6683	87	12.25	42, 43	9.0	39	6.00	40	6.25	1¼	9.8	31		(added 22 bbl oil)
39	Drilling 7⅞" hole, Limestone	6775	92	14.75	44, 45	8.8	41	7.00	42	7.75	1¼	9.9	34		
40	Drilling 7⅞" hole, Limestone	6877	102	15.50	46, 47	6.0	43	8.00	44	7.50	1	9.6	33		(added 31 bbl oil)
41	Drilling 7⅞" hole, Limestone	6962	85	14.25	48, 49	9.3	45	6.25	46	8.00		9.6	34		
42	Drilling 7⅞" hole, Limestone	7062	100	14.25	50, 51	8.8	47	7.00	48	7.25	1½	9.7	35		(added 24 bbl oil)
43	Drilling 7⅞" hole, Limestone	7158	96	12.00	52, 53	7.5	49	5.00	50	7.00	1½	9.3	34		(added 12 bbl oil)
44	Drilling 7⅞" hole, Limestone	7286	128	16.25	54, 55	7.0	51	8.00	52	8.25	1½	9.2	34		
45	Drilling 7⅞" hole, Limestone & Sand	7490	204	17.75	56, 57	6.3	53	9.00	54	8.75	1½	9.2	35		
46	Drilling 7⅞" hole, Limestone	7657	167	17.25	58, 59	6.8	55	9.00	56	8.25	2½	9.2	35		
47	Drilling 7⅞" hole, Limestone	7785	128	18.00	60, 61	5.8	57	9.00	58	9.00	2	9.2	34		
48	Drilling 7⅞" hole, Limestone	7934	149	14.25	62, 63	6.0	59	7.00	60	7.25	¾	9.2	36	65	1/32
48	Drilling 7⅞" hole, Limestone	8027	93	12.75	64, 65	7.8	61	12.75			¾	9.1	40	17	3/32
50	Drilling 7⅞" hole, Limestone	8183	156	16.50	66, 67	7.0	62	8.00	63	8.50	¾	9.1	36	26	3/32
51	Drilling 7⅞" hole, Limestone	8311	128	14.25	68, 69	7.5	64	7.00	65	7.25	¾	9.2	40	20	3/32
52	Drilling 7⅞" hole, Limestone	8400	89	14.50	70, 71	8.2	66	7.00	67	7.50	¾	9.1	43	7	1/32
53	Drilling 7⅞" hole, Limestone	8470	70	9.25	72, 73	8.3	68	9.25			¾	9.4	54	4	1/32
54	Diamond coring, 6⅛" hole, Limestone	8520	50	21.25	75	2.0	CH-1	21.25				9.3	44	4	1/32
55	Pulling core and running drillstem test from 8457 to 8520 ft; ⅝" bottom and 1" top choke, gas to surface in 8 min, oil in 2½ hr, flowed 24 bbl oil in 1½ hr, recovered 4987 ft oil, 619 ft oil and gas cut mud, no water.														
56	Completed test, continued coring	8550	30	9.00	76, 77	8.5	CH-2	9.00				9.3	43	4	1/32
57	Running electric log, reaming	8550			78, 79	9.3						9.3	43	3	1/32
58	Reaming, diamond coring	8568	18	7.00	80	6.3	CH-2	7.00				9.3	44	4	1/32
59	Coring, reaming, running drillstem test. 4-hr test from 8547 to 8575 ft, good blow in 14 min, unloaded 4529 ft of oil.	8575	7	2.00	81, 82	12.5	CH-2	2.00				9.3	43	4	1/32
60	Running electric, gamma ray, and micro logs; running 5½ in. casing with 6 centralizers (8362 to 8563 ft) and 12 scratchers spaced from 8415 to 8567 ft.														
61	Set 5½ in. casing at 8573 ft with 600 sacks 3% gel cement; temperature survey showed top cement at 6490 ft.														
62	WOC; Picking up 2⅜ in. tubing; tested 5½ in. casing with 1000 psi; drilling plug.														
63	Circulating samples and conditioning mud; drilling 4¾ in. hole to 8590 ft in 4¼ hr.														
64	Drilling 4¾ in. hole to 8610 ft, total depth, in 3¾ hr; running 1 hr drillstem test from 8575 to 8595 ft; no show of oil, gas, or water.														
65	Circulating samples and conditioning hole at 8610 ft; running 4 hr drillstem test from 8575 to 8610; good blow of air for ½ hr decreased to weak blow at end of test; no gas to surface; recovered 5683 ft salt water; set cement retainer at 8570 ft and squeezed with 100 sacks slow setting cement, max. pump pressure 2600 psi, pumped 70 sx. away and reversed out 22 sx.														
66	Drilling out plug to 8563 ft; measured out tubing; perforated casing 8500 to 8560 ft with 240 (100-grain) shots.														
67	Running 2⅜ in. tubing to 8557 ft with 3 ft perforated nipple from 8554 to 8557 ft and with packer set at 8180 ft; acidizing with 500 gal mud acid, maximum tubing pressure 1500 psi; opening well to pits for ½ hr, then flowing to tanks, gaging 504 bbl oil and 10 bbl BS on ½ in. choke in 13 hr; GOR 446.														
68	Taking potential test. Drilling rig released.														
68	Totals	8610	8610	587.00	82	311.0	→	→	70	587.00					

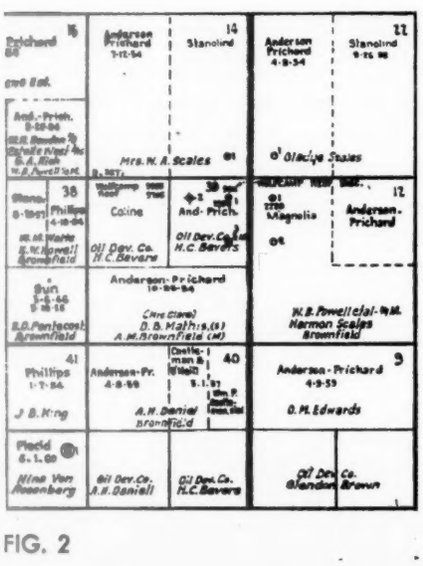


FIG. 2

FIG. 2. Four wells and a dry hole have been completed in the new Wellman field of southern Terry County, Texas, and two wells are being drilled. Placid Oil Company is attempting to extend the field or find a new one about 2 miles to the southwest.

FIG. 3. Only the discovery well has been completed in the new Cotten field of Terry County, Texas. Four other wells are now drilling. This field is about 10 miles northeast of the Wellman field.

Courtesy Southwest Mapping Company

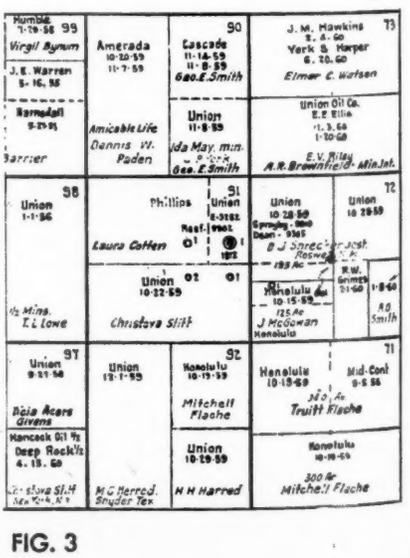
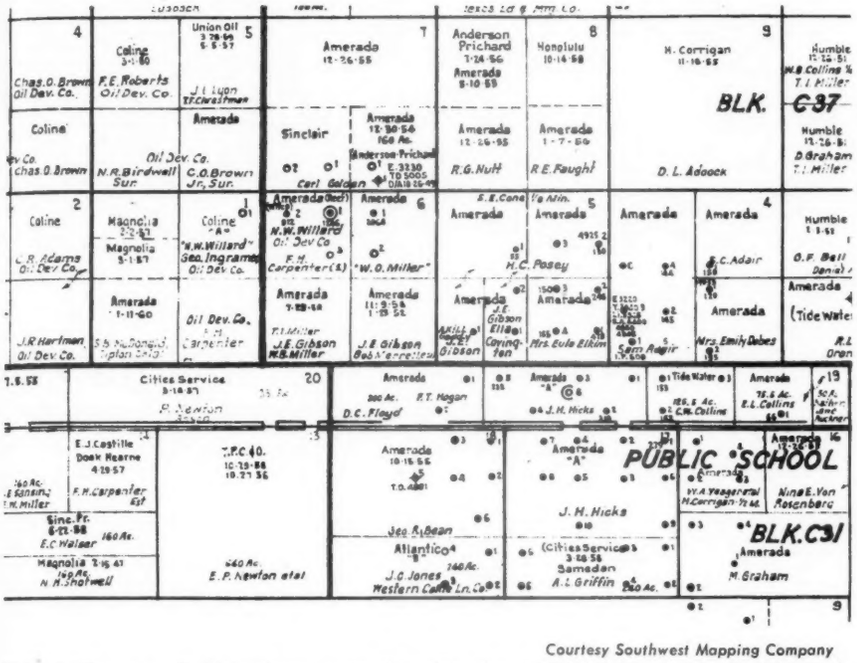


FIG. 3



Courtesy Southwest Mapping Company

FIG. 4. Three wells have been completed in the Adair (deep) field on the north part of section 6, Blk. C-37, on the south side of Terry County, Texas. Six deep tests are being drilled around the discovery and another one is being drilled in the northwest part of the Adair (shallow) field, which was discovered in 1947 and produces from about 4900 ft in the San Andres limestone (Permian age).

are reported to be of Cisco or Canyon (Upper Pennsylvanian) age. Mound Lake is reported to be producing from the Missouri.

In general, however, the reef limestone reservoirs are similar to the Pennsylvanian (Canyon) reefs of Scurry and Borden Counties, and, with the exception of Mound Lake, the reef limestone wells of Terry and Hockley Counties indicate prolific oil-producing capacity. The fields are too new, however, to determine the type of drive or its effectiveness in producing the oil.

TABLE 3. Diamond coring time in a Pennsylvanian reef limestone.

Depth feet	Time minutes	Description
8520—21	10	Trace porosity
21—22	10	Trace porosity
22—23	18	Good fluoresence
23—24	12	Good stain
24—25	17	Trace stain
25—26	15	Good stain
26—27	20	Good porosity and stain
27—28	23	Trace porosity and stain
28—29	21	Trace porosity and stain
29—30	12	Trace porosity and stain
30—31	12	Trace porosity and stain
31—32	15	Slight porosity
32—33	18	Slight stain
33—34	15	Good stain
34—35	11	Good porosity and stain
35—36	17	Good porosity and stain
36—37	16	Good porosity and stain
37—38	16	Slight porosity and stain
38—39	19	Trace porosity and stain
39—40	16	Slight porosity and stain
40—41	19	Trace porosity and stain
41—42	19	Trace porosity and stain
42—43	23	Trace porosity and stain
43—44	20	Trace porosity and stain
44—45	22	Trace porosity and stain
45—46	22	Trace porosity and stain
46—47	22	Trace porosity and stain
47—48	22	Slight porosity and stain
48—49	22	Slight porosity and stain
49—50	22	Slight porosity and stain

Coring conditions:
Weight on bit: 8000 lb
Rotary rpm: 44
Pump pressure: 700 psi
Mud weight: 9.3 lb/gal
Mud viscosity: 43 sec
Water loss: 4 cc
Filter cake: 1/32 in.

Note: 100 per cent of section cored was recovered.

The Terry and Hockley County reef fields are being developed on a 40-acre spacing plan. The allowable production is now 200 bbl per day per well, and the wells are exempt from the Texas statewide shutdown day orders in accordance with the "discovery allowable" incentive plan that rewards operators for finding and developing new pools.

Service Pipe Line Company is running the production from the new Adair (deep) field, and paying its posted price of $2.58 per bbl for 40 API gravity and above. Production from the two wells in the Mound Lake field is shipped by truck to the Texas-New Mexico Pipe Line Company. Production from the Wellman and Cotten fields is likewise being shipped by trucks. The trucking charge amounts to about 26 cents per barrel.

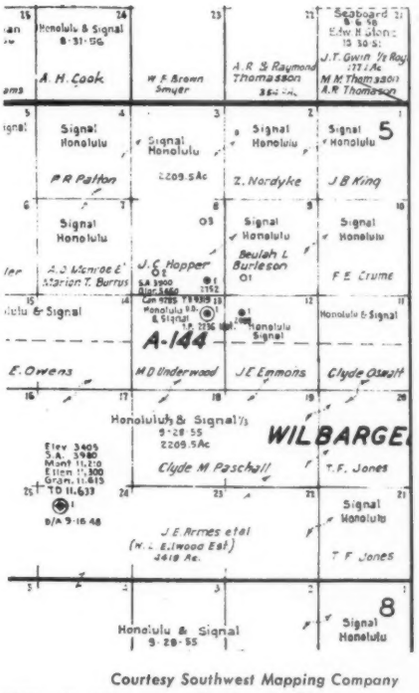
Drilling Conditions

Well locations in this area are as accessible as locations in other parts of the high plains of northwest Texas. One or two shallow water wells are usually sufficient to supply enough water for the power rigs that are used in this area. One such well in the Adair area bailed 20 gal per min from a water sand and gravel bed from 113 to 138 ft deep. It was deepened to 168 ft, where it bailed 35 gal per minute, and supplied enough water for the rig after being cased with 6-in. pipe and equipped with a 4-in. turbine pump.

The wells are usually drilled with natural mud until the mid-string of casing (8⅝-in. or 9⅝-in.) is about ready to be run. Such strings are set from 3000 to 5000 ft with from 500 to 3000 sacks of cement. Temperature surveys are generally run to determine the top of the cement behind the pipe.

The wells are usually mudded up prior to setting the mid-string. Some operators use a saltwater, starch drilling mud, however, most of them are using a colloidal bentonite mud, treating it with caustic, Quebracho, and soda ash. Very little weighting material is used in the mud as lost circulation may become a problem when the weight is more than about 9.5 lb per gallon. Table 2 shows the mud data on a typical well.

The water loss of the mud is lowered to 10 cc in 30 min or below as the prospective producing zone is approached. The mud viscosity varies from 30 to 35 sec until the water loss is reduced, when it increases to about



Courtesy Southwest Mapping Company

FIG. 5. Three wells have been completed in the Ropes field of southeast Hockley County, Texas, and three more are now being drilled. The deep test (about 1 mile SW of the Ropes discovery well) was abandoned as a dry hole about two years before the field was found.

FIG. 6. Reef section of electric log in a deep test in the Adair field.

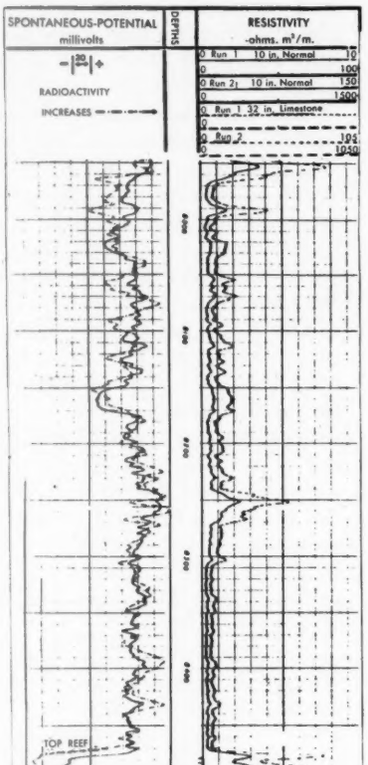


FIG. 7. Electric log of the Cotten field discovery well. Drillstem tests shown on right.

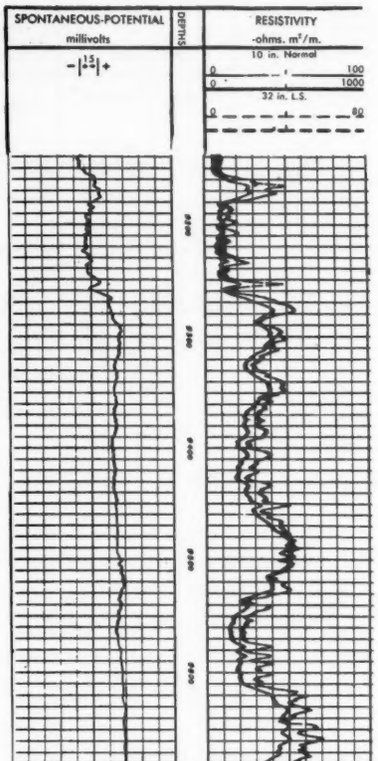
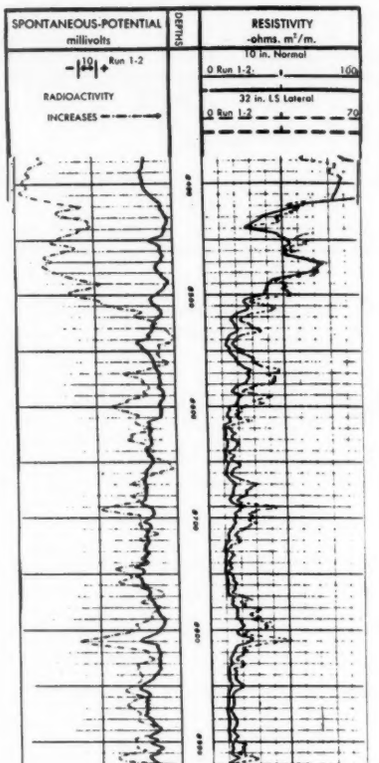


FIG. 8. Electric log of a Ropes field well, Hockley County, Texas.



45 sec. The viscosity is usually kept below 65 sec as a maximum.

About 300 ft of 13⅜-in. surface casing is usually set in a 17½-in. hole and cemented back to the surface with some 350 sacks of cement. From 3000 to 5000 ft of 8⅝-in. casing is set in an 11-in. hole and cemented with from 1500 to 3000 sacks of cement. A 12¼-in. hole is usually drilled, if 9⅝-in. casing is to be run. Casing centralizers are usually run near the bottom of the mid-string.

From 8500 to 10,000 ft of 5½-in. casing is set in a 7⅞-in. hole and cemented with from 300 to 600 sacks of cement. One operator uses 6 casing centralizers and 12 scratchers spaced near the bottom of the oil string. Temperature surveys are usually run to determine the height of the cement behind the pipe. Although it may be advantageous in some instances to set the pipe through the reef limestone producing zone, most operators prefer to set the pipe on top of the producing zone and complete the well through open hole where it seems feasible.

Where the oil string has been set on top of the reef producing zone, the plug is drilled out and the reef zone is diamond-cored or simply drilled out until formation tests and/or other data indicate that sufficient pay has been opened to make a good well. Tubing is then run and connected up and mud displaced with clear water.

Some of the wells completed so far have not been acidized, however, as much as 500 gal of mud acid have been used in others, particularly where the casing has been set through the producing zone and perforated. About 4 shots are used per foot when perforating the casing. * * *

FIG. 1. Casing (10¾ in.), recovered from well, U.P. 403, Wilmington field, California. Plastic type deformation (2 in. offset in 4 ft) at upper earthquake damage level.

Anti-Earthquake Damage Operations

Union Pacific developed unusual techniques to repair its wells when earth shocks prevent them from being produced

D. L. ROBERTS*

Two unusual earthquakes have occurred in the Wilmington oil field within the last three years. They were unusual in that they were "minor" from the standpoint of earth shock but disastrous from the standpoint of damage to oil wells. The first, which occurred in December 1947, affected a large number of Long Beach Oil Development Company wells but only a small number of Union Pacific Railroad Company wells, only two of the latter being rendered non-productive. The second earthquake took place in November 1949, and resulted in damage to a large number of Union Pacific wells. Approximately one-half of these wells were so severely damaged as to prevent them from being produced. Geographically, severe damage to Union Pacific wells was concentrated in an area approximately 5000 ft long and 2000 ft wide, which is situated on Terminal Island.

The damage to wells results from the fact that horizontal earth movement takes place along definite slippage planes during the quakes. Survey techniques evolved to measure the severe deformations in well casings caused by this movement revealed that damage had occurred at about 1500 ft (Fig. 1) and 1700 ft. Most major damage from the second earthquake occurred at the lower level. Correlation of electric log markers showed that slippage planes existed in shale beds at these depths, and subsequent coring confirmed this conclusion. While an extreme variance of depths at which damage occurs of approximately 32 ft above and below the slippage plane exists, the majority of wells damaged have casing deformation within 10 ft of the slippage plane. An average horizontal displacement at the lower level of about eight-tenths of one foot has been measured. The amount of casing affected by the slippage has been found to be as little as 7 ft and as much as 28 ft.

Following the first of these earthquakes, the Union Pacific Railroad Company adopted a policy of installing earthquake damage preventive measures in all new wells in the area of known damage. These measures consisted of the scraping of pockets, which varied in diameter from 20 to 30 in., opposite the known slippage planes. Theoretical investigations of the probable stress involved in earth movements over large areas revealed that any attempts to strengthen well casings so as to be capable of withstanding such movement would be ineffective. A policy of providing larger than normal hole around the casing was therefore instituted, the basic theory being predicated on preventing transmission of formation movement to the casing, or spreading the deformation resulting from such movement over a sufficient length of casing so as to prevent severe damage.

Design of New Wells to Prevent Damage

Following the second earthquake, a correlated program of designing wells to prevent or minimize future damage, and at the same time provide facilities for economic repair of damaged wells, was evolved. This consisted of the setting of approximately 200 ft of 30 in. OD, ⅜ in. wall slipjoint casing, the drilling of 26 in. hole to several hundred feet below the lowest known slippage plane, and the packing of the resultant annulus between the formation wall and the 8⅝ or 7 in. casing with a material suitable for the preservation of the annulus.

The exact practice used in making these installations varies slightly from well to well, but essentially is as follows:

Approximately 5 ft of 38 in. casing is installed when the rig foundation is built. A specially designed riser (approximately 8 ft long) is then flanged to the cellar floor; 18⅝ hole is drilled to about 210 ft, and is then opened to 36 in. diameter. Both blade type scrapers and roller cutter hole openers are used for this purpose. This hole is ordinarily drilled and opened in about 30 hours. Thirty-inch casing is then cemented solidly at approximately

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200 ft. Conventional methods of cementing, using a back-check valve shoe, were employed in the first few wells. The time delay inherent in drilling out a large cast iron insert containing the back-check valve has been eliminated by redesign of the shoe which resulted in elimination of the insert.

At present, the cementing is done by running 3½ in. Hydril internal flush drill pipe to 5 ft above the shoe. A specially designed stripper head is then installed between the drill pipe and 30 in. casing. The cement is pumped through the drill pipe until cement returns are observed. Water is pumped down the drill pipe to clear it of cement; the drill pipe is then pulled through the stripper as high as possible in the derrick or mast and the cement is allowed to set 3 hours, after which the drill pipe is pulled out of the hole.

The alluvial formations in which the surface casing is set are poorly consolidated. Difficulty in cementing surface pipe has been encountered in the past, and at present an admixture of "exploded" perlite in the proportion of 1½ cu ft of perlite to one sack of cement is being used. Use of this mixture results in greater slurry yield per sack of cement (resulting in lower costs), and low slurry weight that has reduced cement losses.

Blow-out prevention prior to the setting of the oil string casing is provided by a specially made split ring, which flanges to the top of the 30 in. casing. This ring in turn supports a specially designed double Hosmer type head with a 26⅞ in. opening. After the 7 and 8⅝ in. casing is cemented, conventional blow-out prevention equipment is installed.

After drilling out the 30 in. casing shoe, an 18⅝ by 12¼ in. "center punch" bit is run to the bottom of the existing 18⅝ in. hole. Approximately 2 ft of 12¼ in. hole is drilled in order to centralize the 12¼ in. bit that is subsequently run. Twelve and a quarter inch hole is then drilled to a depth approximately 300 ft below the lower slippage plane. The diameter of hole drilled below this point is dependent upon the size of casing to be set. If 7 in. casing is to be set, 9⅝ in. hole is drilled; 8⅝ in. casing is set in 12¼ in. hole. Upon reaching the casing setting point an electric log is run and the hole is then opened to 26 in. diameter to approximately 2000 ft.

Normally, this is done in two stages; the 12¼ in. hole is opened to 18⅝ in., which in turn is opened to 26 in. diameter. The pilot type roller cutter hole openers used are conventional in design, although the 26 in. tool is unconventional as regards size, weighing 1710 lb. In all operations described above, clay base mud is used as the drilling fluid except wells in which coring, testing, etc., is to be done above the casing point. Four or five days are normally required for the hole opening operation. Investigation of vertical drilling fluid velocities in the 26 in. diameter hole was made prior to acceptance of the program. This indicated that velocities as low as 0.4 ft per second could be expected if standard pump sizes and rates were used. Since this figure is low when compared to accepted standards, experiments were conducted by adding an extra pump to the system. Subsequent experience, however, has shown that maintenance of drilling fluid in good condition, not velocities, is the primary factor, and very little difficulty has been encountered in this regard. Caliper logs of the large diameter hole were made in a number of the first wells drilled in this fashion, and it was found that the hole diameter was satisfactory so long as good mud control was used.

Many of the wells drilled in this fashion are directionally controlled. Where possible, the well is designed so that directional work will not be done in the hole which is subsequently to be opened to 26 in. diameter. In some instances, however, wells have been kicked off in the hole which is subsequently opened, and directional work done without difficulty; no difficulty has been encountered opening the hole.

After conditioning the hole, casing is set and cemented in normal fashion. A port collar is installed approximately 10 ft below the bottom of the 26 in. diameter hole. The cement is calculated to fill to the port collar. Difficulty was encountered early in the program in preventing cement from channelling into the large hole, although no large quantities of cement above the port collar were found. Two methods of controlling the height of rise of the cement have been used with excellent results. First, a series of cement slurry mixes of graduated weight and viscosity were evolved. Each was selected largely on the basis of the height to which the cement had to be pumped. Bentonite type clays and "exploded" perlite have been used to obtain desired slurry weights and viscosities. Secondly, the rate of displacement of the cement was increased considerably above normal practice. Temperature surveys indicated that a deviation of approximately 4 per cent between actual and calculated rises has been attained in most cases since the changes were made.

After displacement of the cement, the port collar is opened as soon as

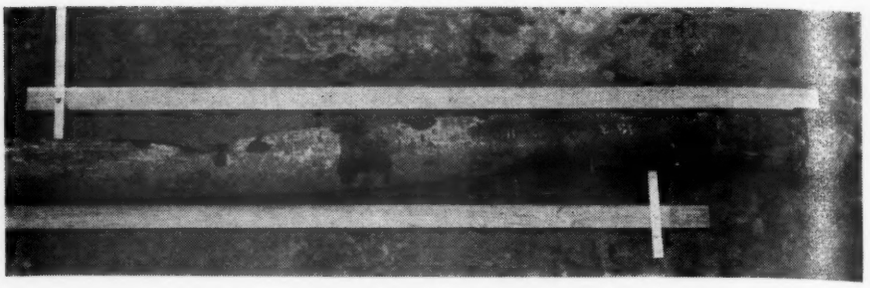


FIG. 2. Typical artificially deformed test specimen. Compare with actual specimen of deformation (Fig. 3).

FIG. 3. Casing (10¾ in.), recovered from well U.P. 376, Wilmington field, California. Plastic type deformation (8 in. offset in 4 ft) at lower earthquake damage level.

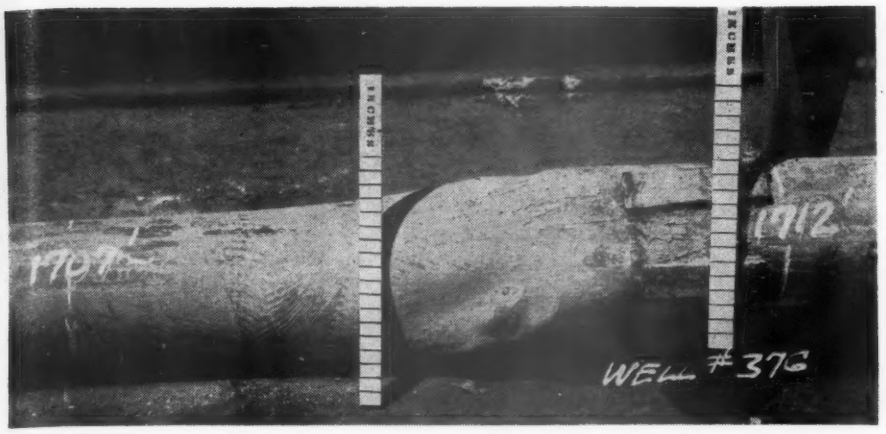
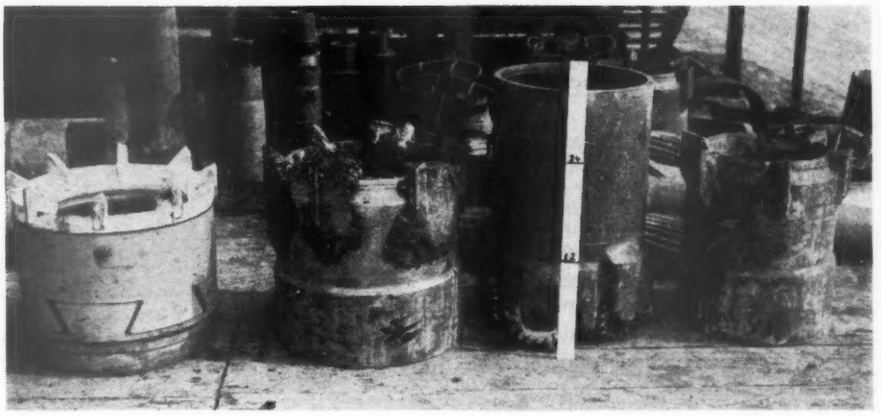


FIG. 4. Left, side view of casing shown in Fig. 3. Maximum width, 13⅜ in.

FIG. 5. Drag type washover shoe on articulated joint, which screws into flexible washover casing section.

FIG. 6. Left to right: Drag type washover shoe for flexible washover joint; drag type washover shoe for use on 21 in. washover pipe; roller cutter shoes; drag type shoe for use on 16-in. washover casing.



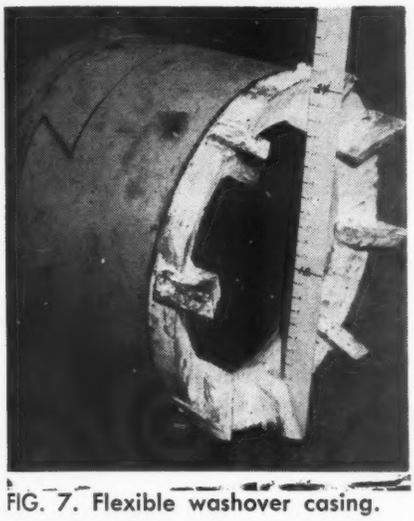
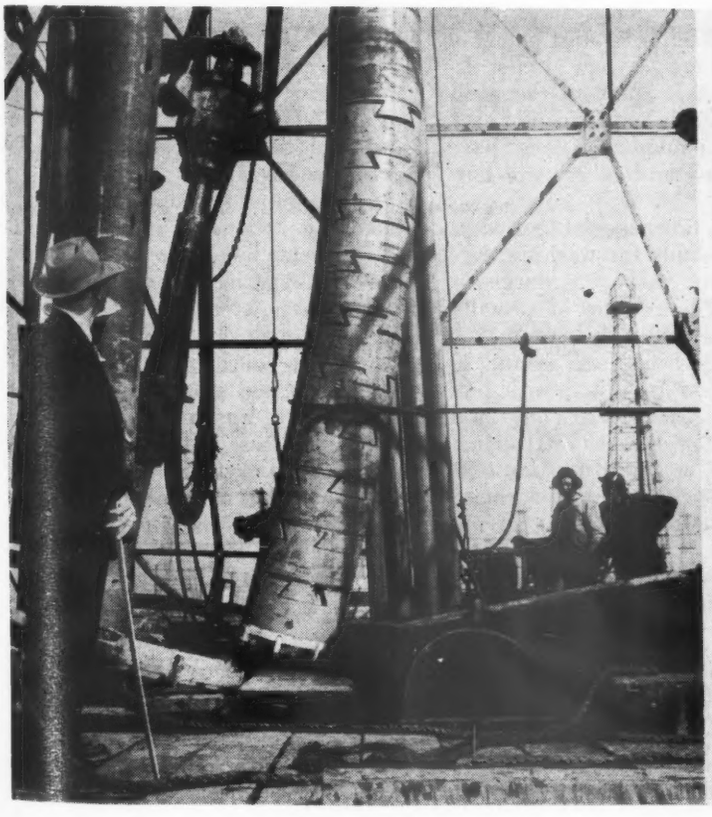


FIG. 7. Flexible washover casing.

FIG. 8. Casing (10¾ in.), recovered from well U.P. 403, Wilmington field. "Shock" type deformation at lower earthquake damage level. The specially designed outside casing cutter is also shown; rectangular pockets in the body contain the cutting knives.



practicable and the annulus circulated thoroughly with clay base mud. The mud is treated if necessary in order to condition the annulus for placement of the special packing material. The annulus is then completely displaced with an emulsion type mud that is treated to obtain a very low water loss and an extremely high gel strength. After complete gellation, the consistency of the mud pack is such that a pencil thrust into it will remain upright indefinitely. Measurement of the gel strength is made by use of a specially modified shearometer tube. The success of the program is demonstrated by the fact that less than 94 per cent of the calculated displacement volume has been placed in only a very few cases. In some cases, 106 per cent of the calculated displacement volume has been reached.

After completion of the above work, the well is completed in normal fashion.

The uppermost sediments on the Union Pacific Railroad Company's property, to a depth of approximately 1450 ft, are comprised largely of clay and silt members and medium to coarse-grained unconsolidated sands. Since the entire program is predicated on maintenance of the large hole diameter in order to permit earth slippage without transmittal of large localized stress concentrations, it is essential that the diameter of the hole be maintained. In order to determine the effectiveness of the fluid used in the annulus in this regard, the annuli are refilled periodically, and a program of thief sampling of the fluid has been instituted.

Recovery of Damaged Wells

Following the earthquake, remedial and recovering processes were evaluated both from the point of view of mechanical effectiveness and of economics. A series of experiments were conducted both on surface test specimen and on wells. (Fig. 2.) From these, it was concluded that any attempt to repair wells from the "inside" (i.e., milling, swedging, etc., inside the casing) was unlikely to succeed due to the unique type of deformation encountered. The lateral slippage spoken of above usually results in the offsetting of two more or less parallel limbs of the casing. (Figs. 3, 4.) As a result, attempts to remove the constriction by milling or swedging almost invariably results in cutting or breaking the side wall or pipe, thus permitting the tool to follow a prolongation of the axis of the upper limb, rather than the axis of the bend. A specially designed flexible drill collar and rotary bit type swedge was used to open severe constrictions in a test specimen to approximately normal internal diameter. A subsequent attempt to use this equipment to restore normal internal diameter in a well casing was abandoned because of slow progress. As a result, emphasis was given to other methods.

FIG. 9. Another view of 10¾-in. casing recovered from U.P. 403.

In order to provide the maximum amount of protection against potential earthquake damage, new wells designed to replace many of the wells that are completely unproducible have been drilled. A number of these have been completed and others are now being drilled.

At the same time, special tools were designed and built for washing over and recovering casing as large as 11¾ in. OD. These consist of specially built drag type and roller cutter type washover shoes, heavy wall 16 and 20 in. washover casing fitted with tool joints, and external casing cutter and a flexible section of washover casing. (Figs. 5, 6.) The latter is made of a series of interlocking cast steel rings; the joints permit a deflection of approximately 2 ft laterally at the bottom of a 10-ft section of the casing. (Fig. 7.) Each joint is sealed with a rubber insert sleeve so that circulation can be maintained through the section.

To date, three wells have been worked on with this equipment. One has been completely recovered; another was washed over to the 1700 ft level below which the well was deflected and redrilled. The third has been washed over to the 1700 ft level. The condition of the casing recovered by the use of this equipment indicates that the casing failures have been due to local concentrations of very large stresses. Although some plastic deformation above and below the point of failure can be seen, the failure itself in one case exhibited characteristics more nearly associated with the result of high velocity shock wave than with the result of a relatively slow bending process. (Figs. 8, 9.)

In designing surface equipment for installation in wells in which the 26 in. diameter hole is to be drilled, the use of this special washover equipment for economic recovery of wells that may be damaged by future earthquake action was considered. Thus, the size of the surface casing was determined by the size of washover tools and pipe. since in the case of the wells that have been washed over to date it was found that removal of drive pipe and surface casing was costly and time consuming.

As the final test of the effectiveness of the program for preventing or minimizing earth slippage damage to the wells necessarily involves the occurrence of another earthquake, a full evaluation of the program is not now available. Theoretical evalutions of the program are being made, however, and changes introduced as they are deemed necessary. * * *

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So effective is Strata-Seal's bridging action, that even in a number of extreme cases, it has restored circulation and saved abandonment of wells.

Check these savings with Strata-Seal

1. Strata-Seal protects investments by making possible reclamation of wells about to abandoned.
2. Eliminates or reduces rig down time.
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4. Has no detrimental effect on viscosity, water content and gel strength of drilling fluid.
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Manufactured to rigid specifications, Strata-Crete is a uniform aggregate which can be used with high early, slow set, or standard oil well cement. It's suitable as an admix in bulk cement, or can be mixed right on the job.

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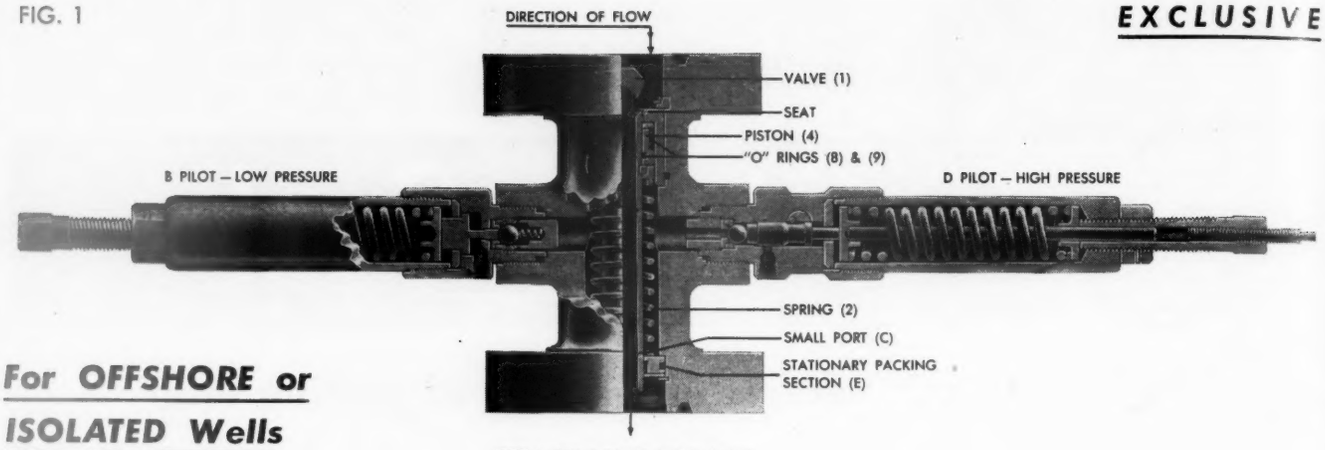
FIG. 1



TYPE A OTIS SURFACE SAFETY VALVE

EXCLUSIVE

For OFFSHORE or ISOLATED Wells

Automatic Surface Safety Valve

C. A. KIZER

A NEW and simple type of automatic surface safety valve is now being used in the oil and gas producing industry. This new valve combines certain features of two safety devices familiar to the producing industry along the Gulf Coast. The method of shut off in the removable tubing safety valve has been brought to the surface and combined with the extremely accurate high and low pressure pilot valves from the type "X" surface safety valve to form what is known as the type "A" surface safety valve.

The type "A" surface safety valve is similar to its predecessor, the type "X", in that it utilizes the pressure within the valve bore for the energy to close itself—requiring no outside lines in most installations.

This minimizes the danger of hydrates freezing to block action of the safety device when it is most needed.

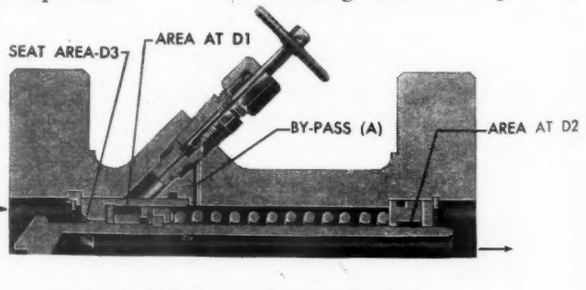
This new type "A" valve, as shown in Fig. 1, consists of a valve body bored to contain an inner valve assembly, two pilots that are threaded into the body at right angles to the line of flow, and a by-pass valve, which controls the by-pass, Fig. 1A, necessary for re-opening. All the working parts of the valve, as well as all parts exposed to the well fluids, are made of corrosion resistant metals.

As stated previously, this valve is operated by pressure from within the valve body. Referring to Fig. 1, the valve is shown in an open position, with flow as indicated by arrows passing through the inner bore of the valve (1). The spring (2) serves to hold the valve (1) open against the frictional force set up by flow.

Pressure existing in the valve body is also exerted in the annular spring chamber through very small ports (C). The annular chamber is closed at the downstream end by a stationary packing section (E). At the upstream end, this chamber is sealed off by O-Ring packings (8) and (9), carried on the piston (4). The pilots (B) and (D) are connected to this chamber and are thus subject to the same pressure existing in the bore of the valve. The by-pass, Fig. 1A, is closed off by means of needle valve assembly.

When pressure within the valve bore rises to an amount considered unsafe, the Type D, high-pressure pilot opens with a snap action to release the pressure from the annular spring chamber to atmosphere. In like manner, if pressure on the flow line drops to a point below any normal surge—indicating a large leak or actually a break—then the Type B, low-pressure pilot opens to release the pressure in the spring chamber. The pressure drops in this spring chamber to atmospheric almost instantaneously as the capacity of the inlet port (C) is only a fraction of that of the exhaust ports in the pilots. There is, therefore, a differential pressure exerted across the piston (4) in the direction of flow because of the area represented by the diameter of the piston at D1 minus the area at D2 being exhausted to atmosphere while the full area at D1 upstream of the piston is subjected to flow line pressure at all times. (See Fig. 1A).

This resulting differential pressure



QUARTER SECTION VIEW SHOWING BY PASS

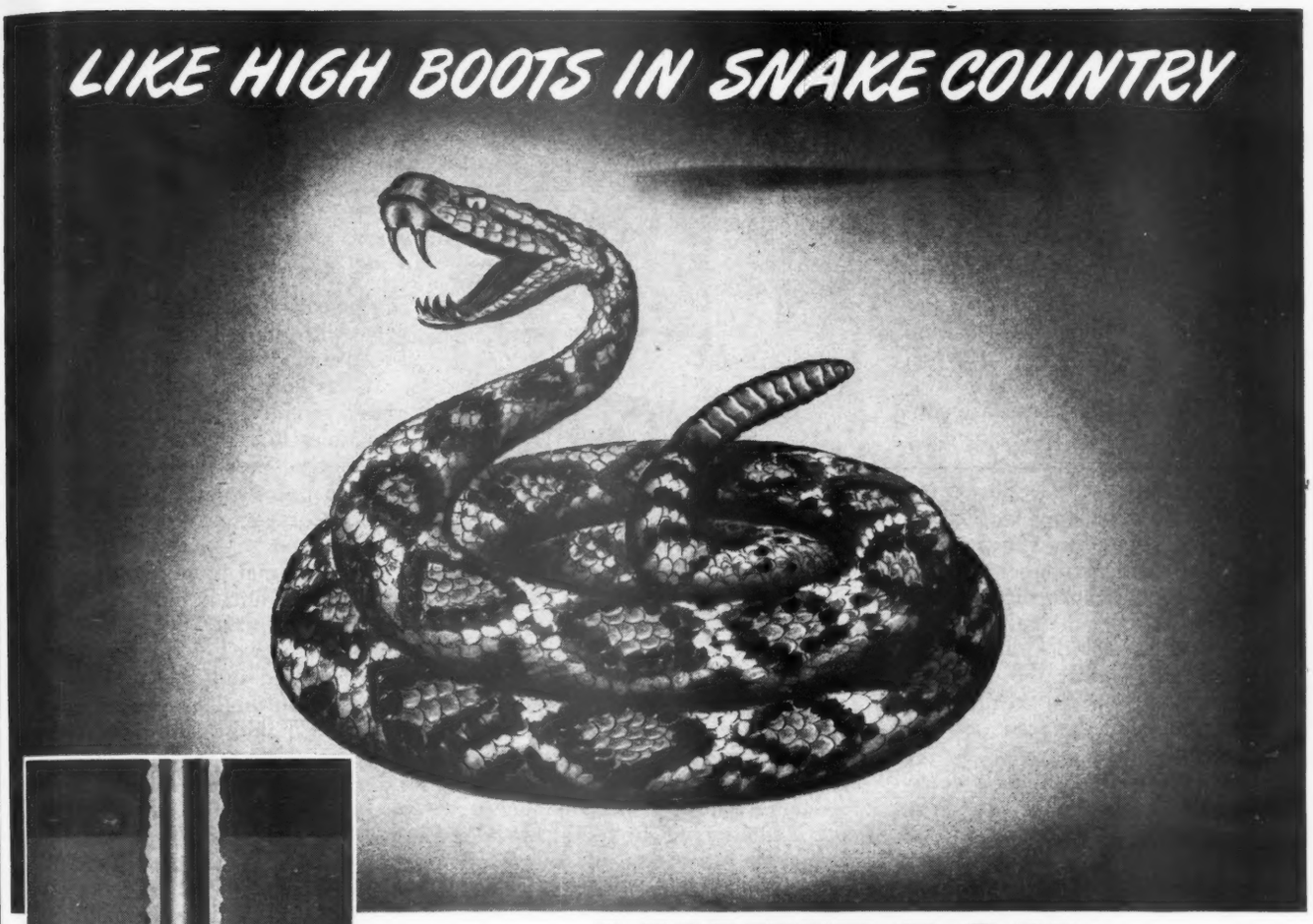
FIG. 1A

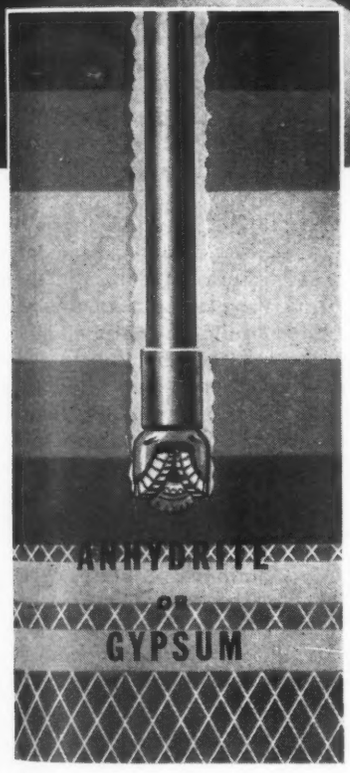
†Manufactured by Otis Engineering Corporation, Dallas, Texas.

The Author

C. A. Kizer is a petroleum engineer on Otis Pressure Control's home office staff in Dallas. After receiving his degree from Texas A. and M. College in 1940 he joined Otis and has been with them continuously except for five years' service in the Air Forces during World War II.

LIKE HIGH BOOTS IN SNAKE COUNTRY





ANHYDROX

Prevention being always better than cure, the experienced hiker guards *against* being bitten—and many experienced oil operators add ANHYDROX to the mud *before* gypsum or anhydrite contamination occurs. That's because you can't overtreat with ANHYDROX—an excess amount can't harm the mud. Either as a pretreatment or as a restorative measure, ANHYDROX is truly a panacea against gypsum and anhydrite contamination. Added to the mud as a precautionary measure, it maintains the mud in original condition in the face of large amounts of calcium sulphate: if untreated mud has become contaminated and flocculated by anhydrite or gypsum, or even by calcium sulphate in the mud-mixing water, ANHYDROX removes *both* the harmful calcium and sulphate ions, and restores the mud to its original condition. ANHYDROX treatment maintains, or restores, the original viscosity, gel, and filtration characteristics of the mud—and takes a lot of worries off the operator's mind.

Your Baroid Field Man will be glad to tell you more on what ANHYDROX will do for you.

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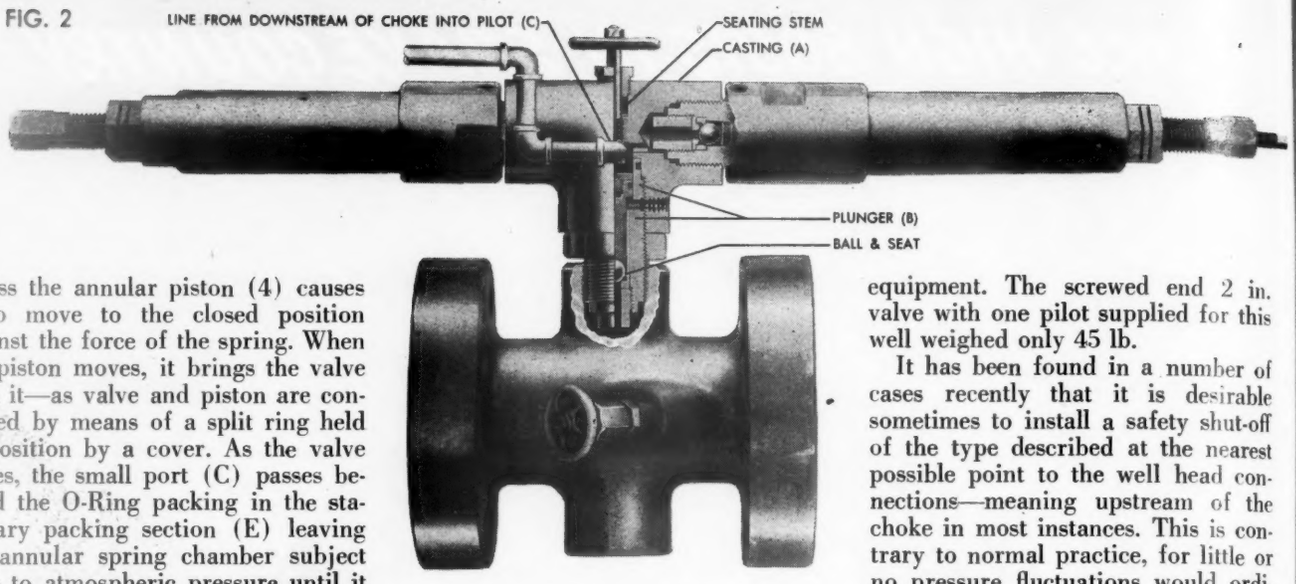
Complete Drilling Mud Service

FIG. 2



M PILOT FIXTURE ON TYPE A OTIS SURFACE SAFETY VALVE

across the annular piston (4) causes it to move to the closed position against the force of the spring. When the piston moves, it brings the valve with it—as valve and piston are connected by means of a split ring held in position by a cover. As the valve closes, the small port (C) passes beyond the O-Ring packing in the stationary packing section (E) leaving the annular spring chamber subject only to atmospheric pressure until it is desired to re-open the valve. When the valve has closed, the differential pressure acting against the full seat area at D3, which is even greater than the annular area of the piston, holds the valve closed. The valve can be re-opened only when the by-pass valve (A) is opened to equalize pressures across the annular piston area.

From the above description of the valve, several distinct advantages of this Type A valve may be seen. First, the means of shut-off (taken from the valve of a removable tubing safety valve) is known to be reliable and positive, having been thoroughly proved in hundreds of installations. Secondly, the valve is virtually frictionless, which makes possible a number of new applications heretofore impractical in a safety shut-off. The fact that there is no stem or control packed off to atmosphere when in use has provided in this Type A valve a relatively trouble-free, simple design.

The accuracy of the pilot valves has been proved in some 600 installations over the past three years in the use of the Type X surface safety valve. These pilots have no packing in them whatsoever and therefore, when set for a certain pressure, they will retain that setting over extended periods of time or repeated actions. There are a number of installations where the setting of the pilots must be accurate within two pounds per square inch, and they are actually checked each month—so important is the protection provided.

One feature of this new valve that should impress field men is the comparative ease with which the valve may be opened after closing. All that is necessary is to close the pilot that opened to actuate the valve, and then to "crack" the needle valve on the by-pass, which will open the valve by means of pressure alone.

It may be seen from a careful examination of this design that there is no natural trap for the accumulation of hydrates, which might freeze and foul the operation of the safety device. The valve has been field tested on a well producing hydrates in such quantity as to actually plug the tubing without fouling the operation of this safety device in any way.

The ease with which the valve may be opened or closed suggests its use as a remotely operated valve by the use of a diaphragm control on the by-pass rather than the snap-opening pilots to automatically close the valve.

The small, compact size of this valve is another desirable feature. There are screwed-end or flanged-end valves available in the normal flow line sizes and in a considerable range of test pressures. As yet, no pipe line size valves have been designed. Although there is a restriction in the valve bore to a one-inch opening in the 2-in. size valve, there is only a very slight pressure drop across the tool unless excessive volume of fluids are passed. About 11,000,000 cu ft of gas per day have been passed, resulting in only a 40 psi drop across the valve.

In flowing an oil well situated in the protected water near Mustang Island to a separator island at a pressure of about 25 psi, the operator desired to protect the well from flowing wild, if the line were to break. It was possible to provide an accurate pilot setting as low as 15 psi, but the new Type A was the only method of shut-off available that was shown to be free of friction to the extent that 15 psi would always operate it effectively. One of the requirements for a valve in this case was that it be light enough for one man to lift, as the new location did not have a scaffold around it that would permit easy handling of heavy equipment. The screwed end 2 in. valve with one pilot supplied for this well weighed only 45 lb.

It has been found in a number of cases recently that it is desirable sometimes to install a safety shut-off of the type described at the nearest possible point to the well head connections—meaning upstream of the choke in most instances. This is contrary to normal practice, for little or no pressure fluctuations would ordinarily occur upstream of the choke when the flow line pressure downstream would indicate a break or a freeze up. In this instance a new style fixture for holding both high and low-pressure pilots has been developed, allowing the downstream pressure to be brought into the valve and open the pilots when this downstream pressure exceeds set limits. Again, when the pilots open, the safety valve would close, shutting in the well at the christmas tree.

Such a pilot—called the Type M—is shown in Fig. 2 and consists of a casting (A) screwed into the main body of the valve and threaded to hold one or more of the conventional pilots. Inside the casting, a plunger (B), larger on one end than the other, holds a ball against a seat. As long as a given amount of downstream pressure is brought into the M pilot at (C) acting against the larger end of the plunger, the ball will remain on the seat, sealing the annular spring chamber of the main valve body. Whenever the downstream pressure varies to the extent that one of the pilots is opened and this pressure behind the larger end of the plunger is exhausted, the plunger will no longer hold the ball on the seat, and the pressure in the annular spring chamber will be exhausted to atmosphere, closing the safety valve upstream of the choke in the same manner as described before.

This upstream version necessitates one outside connection under pressure as well as a small check valve, but enables a safety device to be installed on the christmas tree that is operated by undue fluctuations in pressure downstream of the surface choke. If this outside line is broken accidentally, the safety device would close automatically; so that the valve, even with this outside line, should prevent a well from flowing out of control. * * *

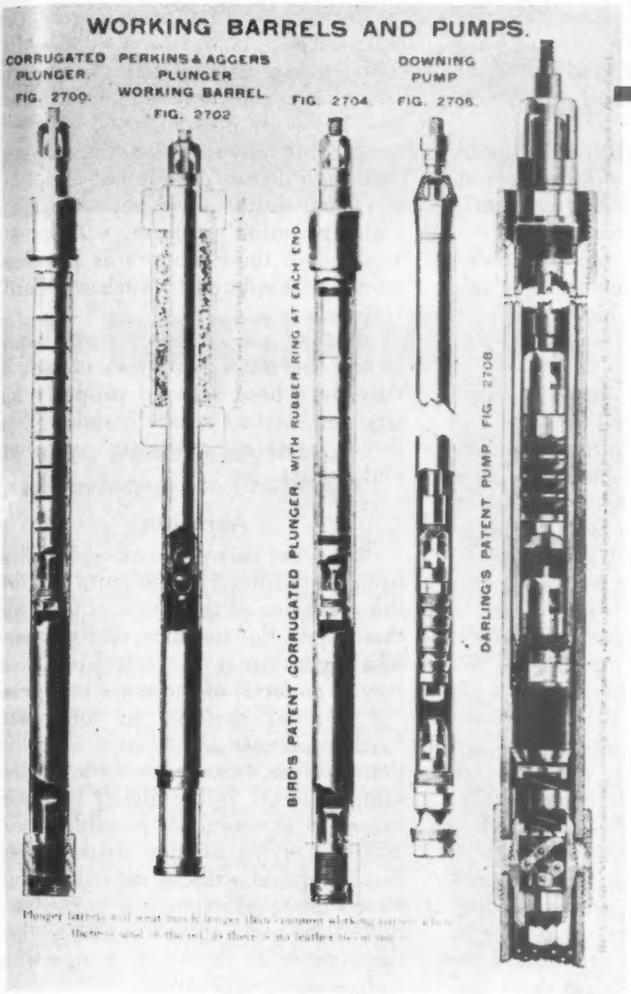
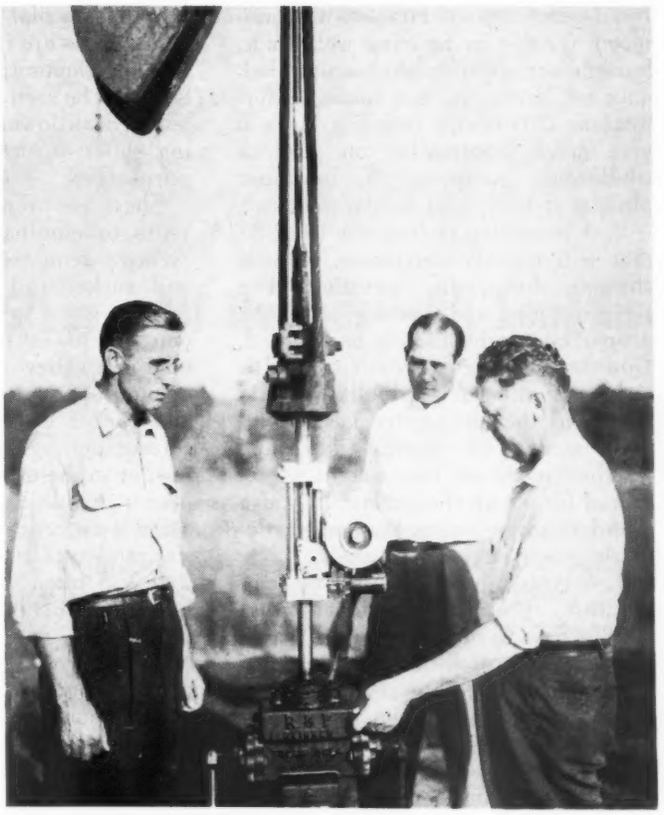

WORKING BARRELS AND PUMPS.
CORRUGATED PLUNGER. FIG. 2700.
PERKINS & AGGERS PLUNGER WORKING BARREL FIG. 2702
FIG. 2704
DOWNING PUMP FIG. 2706.
BIRD'S PATENT CORRUGATED PLUNGER, WITH RUBBER RING AT EACH END
DARLING'S PATENT PUMP FIG. 2708

FIG. 1. Pumps from catalog published in 1900.

FIG. 2. Dynagraph—well weighing instrument.



"On the Beam" Pumping†

J. S. FULLER*

FEW, indeed, are the oil wells that produce to completion without being "on the beam" at some time in their history. The term, "on the beam", is generally recognized to cover the use of a pumping unit, sucker rods, and a reciprocating bottom hole pump.

About 450,000 wells in Canada, the United States, and Mexico are now being produced "on the beam". Between 75 and 80 per cent of all oil wells are so produced. Other methods of lifting oil are being used, however, most of these are limited to special applications; such as utilizing gas-lift, where adequate gas and compressor capacity is available.

Within the "on the beam" class of equipment, we find considerable variation in surface elements, such as the long stroke hydraulic units, various types of prime movers, and similar variations.

Fig. 1 illustrates working barrels and pumps that were shown in catalogs issued about the year 1900. This equipment looks very familiar and should impress us with how little the basic principles of pumping have changed with the years. It is true that modern equipment is heavier, stronger, and more adaptable, but it is in the material and the "know how" and not in the principle where the greatest strides have been taken. To those who have ridden the air lines on days when the ground was obscured by clouds, the ability of the pilot to hold his course direct to his destination leads us to a realization of the important place that instruments play in modern commerce. These planes are held on their course by beamed radio signals. By a slight change in sound, the pilot is warned when the plane is "off the beam", and some of these ships of the air are equipped with automatic pilots to keep them "on the beam".

Tools

The modern producing company can no longer afford "cut and try" methods and should equip its personnel with proper tools. By tools, we mean the instruments that will tell not only how but how much. Only with

†Presented at the Oilfield Technical Society, Calgary, Canada on August 28, 1950.

*Manager, Production Equipment Sales, Oil Well Supply Co., Dallas, Texas.

such tools can we keep our operations "on the beam".

It is suggested that operating companies having production engineers make available most of the following instruments for routine use:

1. A compact, accurate, polished-rod dynamometer complete with planimeter for use in figuring well loads, horsepower requirements, counterbalance requirements, and similar information. This device (see Fig. 2) will give much information on gas-lock conditions, pumping off, improper plunger spacing, and similar data.

2. A recording tachometer (Fig. 3) that will quickly determine, without shutting down, the operation of a pumping unit, and whether or not the proper counterbalance is being used. Counterbalance needs vary with changes that occur gradually within a well, and the tachometer is the simplest means to quickly determine whether more or less weight is required for counterbalancing. It is also useful in prime mover studies, particularly where engines are used.

3. A bottom hole pressure and temperature recording instrument that may be used to obtain data that, when plotted, will provide a history of energy depletion, natural water drive, danger of gas coming out of solution by over production, and similar worthwhile facts.

4. A pH value instrument (Fig. 4) that should be worthwhile in identifying acid conditions in the well fluid. Various chemicals such as lead acetate and calcium hydroxide may be used for identifying gases causing corrosion. Some producing companies have been slow to accept simple chemical processes as an aid to lower lifting costs.

5. Electrical potential indicating instruments that will point to stray currents flowing in or out of a well, and lead to the use of insulating flanges in flow lines, gas lines, etc. Where leases are electrified, portable kilowatt meters, volt meters, and ammeters, should be valuable to us.

6. A full set of API thread gages for box and pin threads on sucker rods should be available where a large number of wells are in operation.

7. A Depthograph or Echo-Meter that may be used for determining fluid levels, drawdowns, the location of seating shoes or packers, and for other purposes.

There has been a tendency in recent years to eliminate well history and "service rendered" charts on pumps and sucker rod installations. These records are a necessity, if best economy and lowest lifting costs are to be obtained. They should reveal causes of poor service on the part of pumps and sucker rods and often point to certain pulling crews as being careless, or to the use of worn tools or improper handling methods. They become a record as to the best grade, size, and type of equipment for each well and often indicate the need for inhibiting corrosion on certain wells.

Pumps

Fig. 5 shows the six types of subsurface pumps. They are the tubing type, using a full barrel of one piece construction, and the sectional liner barrel, composed of several short sections enclosed in a jacket, together with three types of rod pumps that are of stationary or traveling barrel design. The rod pumps may be either full barrel or liner type, and the stationary barrel construction may be supported either at the top or at the bottom. The sixth drawing indicates one of the many variations using double balls and seats in both the standing valve element and in the traveling valve element.

Dimensions have been largely, but not entirely, standardized by the API. This standardization has made parts interchangeable between manufacturers. There are no standards, however, concerning materials, loading stresses, or design details that do not affect interchangeability. It is hoped that no standardization program will be attempted in these matters as progress would be hindered by such standardization.

Most of the problems concerning pumps fall into one of three classes, if they have been selected properly for size and contact stroke length. These three classes are abrasion, corrosion, and impact.

Abrasion

Abrasion, or wear, is best handled by high hardness in the parts and by the character of the material used for these parts. For instance, castings may have better wear characteristics than forged material of the same hardness.

Dissimilar material in the lower hardness ranges gives better wear life than having two parts made of the same material. In the higher hardness ranges, it is sometimes possible to use a barrel and a plunger made of the same material without difficulty. This allows an equal expansion or contraction of the plunger and barrel, so that the plunger fit does not change with a change in temperature.

Tubing pump barrels (the common working barrel) are usually of cold drawn steel of comparatively low hardness, or the barrels are made of cast materials either in one piece or of sectional construction. Either forged or cast material can be hardened by heat and chemical methods.

Metals other than those of iron such as brass, monel, or chromium-plated steel are sometimes used. Their costs are relatively high, and their use is

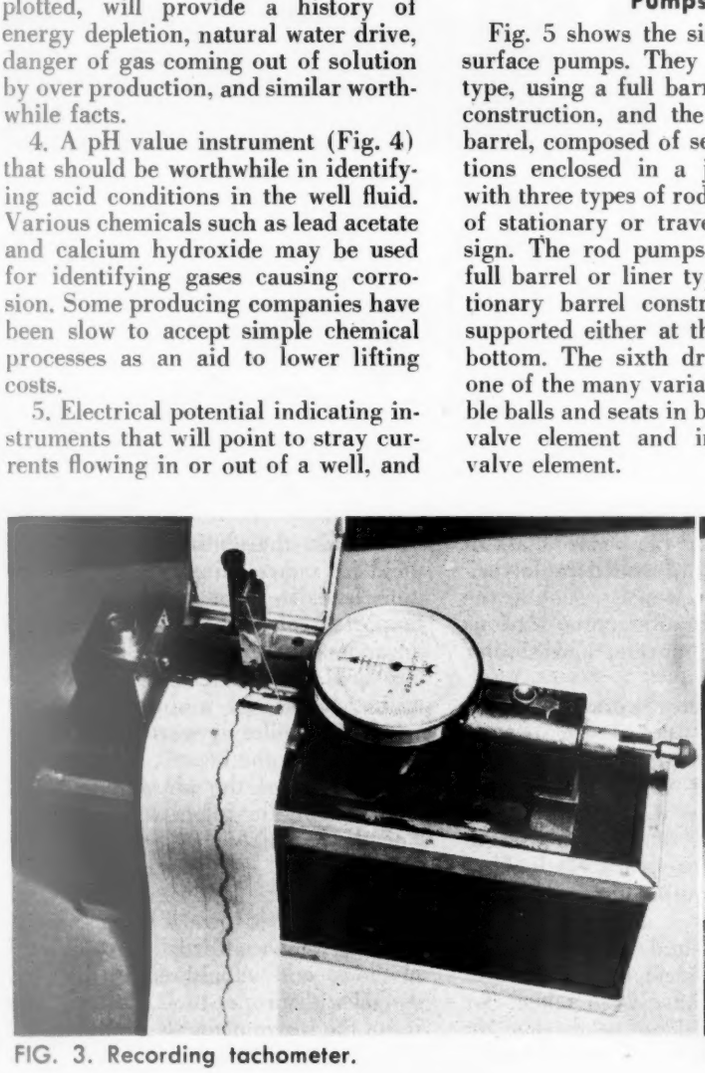


FIG. 3. Recording tachometer.

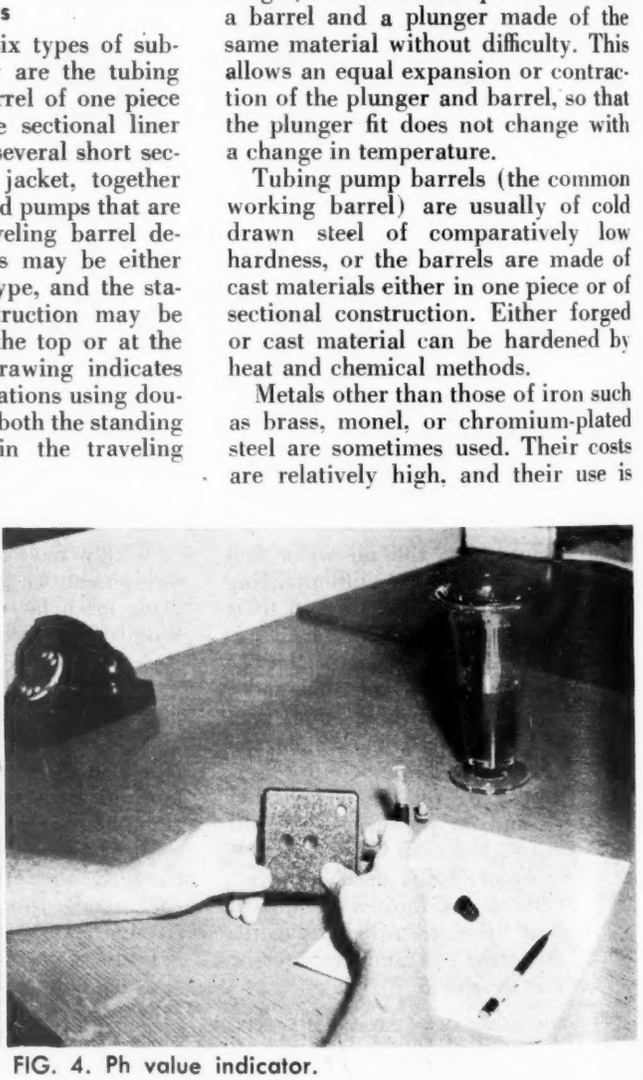


FIG. 4. Ph value indicator.

Baash-Ross News

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PLUS the Most Advanced Construction and Metallurgical Features!

FOR YEARS Baash-Ross has led in the development of a superior line of square Kellys to meet the increasingly rigid requirements of modern drilling operations. And best of all, these top-quality Kellys are available in a range of sizes and designs to meet every operator's need... with or without stop shoulders, elevator spaces, etc.... and in all lengths.

In fact, Baash-Ross provides everything in square* Kellys!

They have Everything in Performance Features!

● Baash-Ross Square Kellys are forged end-to-end from one solid piece of restricted analysis, fine-grained alloy steel, with each heat of steel individually checked for quality by separate test specimens.

After forging and before heat treating, the dimensional accuracy of the forged square section is checked by an API Kelly Sleeve Gage which must pass freely over the entire length of the square to check maximum allowable tolerances across flats and across corners. Also, accurate caliper measurements are taken to make sure no portion of the driving section is undersize!

● Next, a series of heat-treating operations performed over the *entire length* of the Kelly in one operation, develop the metallurgical properties of the steel to provide the *best balance* of shock-resisting toughness and wear-resisting hardness.

● Additional heat-treatments harden the threaded ends for maximum life and service.

● All residual forging stresses are relieved by these heat-treating processes, thus eliminating the most prevalent cause of bending and deformation.

● The Kellys are then carefully bored by precision drilling machines so that the bore is precisely centered end-to-end, then double-checked by highly-accurate survey devices. For products with bores 2¼" diameter or larger, wall thickness of the Kelly *must not* vary more than *one-sixteenth* inch for each 10 ft. of product length, or fraction thereof.

● The Kelly itself is also accurately surveyed for straightness and *must* be straight within *one-eighth* inch when measured at any point over its entire length.

● The alignment of the projected axis of each threaded end, when checked with the precise Baash-Ross Alignoscope, *must* be within *one-eighth* inch of the longitudinal axis of the Kelly for each 10 ft. of Kelly length, or fraction thereof.

● In addition, threads *must* pass, not only all API specifications, but also unusually rigid Baash-Ross specifications on thread form, taper, lead, finish, etc.

The above highlight only a few of the many controls maintained by Baash-Ross to insure absolute straightness, long-life and maximum all-around performance from every Baash-Ross Kelly!

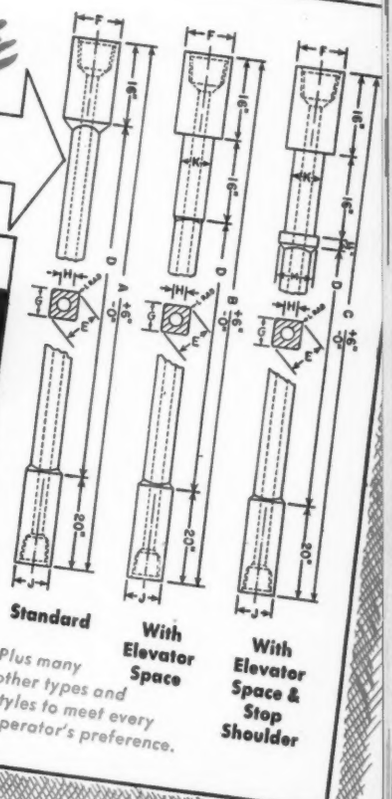
They are Available in

.. All Sizes ..All Designs

Baash-Ross "Trubore" Forged Upset Square Kellys

Nominal Size In.	LENGTHS Overall A Ft.	Overall B Ft.	Overall C Ft.	Working Length D Ft.	Top Upset Joint Size A.P.I. Left Hand In.	Top Upset O. D. E In.	Bottom Upset Joint Size A.P.I. Right Hand In.	Bottom Upset O. D. J In.	Bottom Upset I. D. H In.	Bore Across Corner F In.	Across Flat G In.	Elevator Space O.D. K In.	Elevator Space Corner Radius L In.	Stop Shoulder O.D. M In.	† Cu. Ft. per Lin. Ft.
2¾	35 38 40	36–4 39–4 41–4	36–6 39–6 41–6	32 35 37	4½ Reg. 6⅝ Reg.	5½* 7¾	2¾ Reg 2⅞ I.F.	3¼ 3⅜	1⅛ 1¼	3⅜₃₂	2⅞	2⅜₁₆	⁹⁄₁₆	3⅝	*.165 .327
3	35 38 40	36–4 39–4 41–4	36–6 39–6 41–6	32 35 37	4½ Reg. 6⅝ Reg.	5½* 7¾	2⅞ Reg 2⅞ I.F.	3⅝ 4⅛	1⅜ 1⅝	3¹⁵⁄₃₂	3	2¹⁵⁄₁₆	⅝	4⅛	*.165 .327
3½	35 38 40	36–4 39–4 41–4	36–6 39–6 41–6	32 35 37	4½ Reg. 6⅝ Reg.	5½* 7¾	3½ Reg. 3½ F.H. 3½ I.F.	4¼ 4⅜ 4⅝	1½ 2⅛ 2¼	4¹⁵⁄₃₂	3½	3¹⁹⁄₃₂	⅝	4¾	*.165 .327
4⅛	35 38 40 54	36–4 39–4 41–4 55–4	36–6 39–6 41–6 55–6	32 35 37 51	4½ Reg. 6⅝ Reg.	5½* 7¾	4⅛ Reg. 4½ F.H. 4½ I.F.	5¼* 5⅝ 6⅛	2¼ 2⅝ 2⅝	5⅜₁₆	4⅛	4¹⁹⁄₃₂	⅝	5¾	*.165 .327
5⅛	38 40 54	39–4 41–4 55–4	39–6 41–6 55–6	35 37 51	6⅝ Reg.	7¾	5½ Reg. 5½ F.H. 5½ I.F.	6¾ 7⅜	2¾ 3⅛ 3⅛	6²³⁄₃₂	5¼	5⅝	⅝	7	.327
6	38 40 54	39–4 41–4 55–4	39–6 41–6 55–6	35 37 51	6⅝ Reg.	7¾	6⅝ Reg. 6⅝ F.H.	7⅝ 8	3½ 3½	7⅞	6	6¾	⅝	8	.327

Sizes shown in RED are A.P.I. standard.
* Alternate 5⅝ inches O.D.—.180 cu. ft. per lineal ft
† Volume based on largest diameter of kelly



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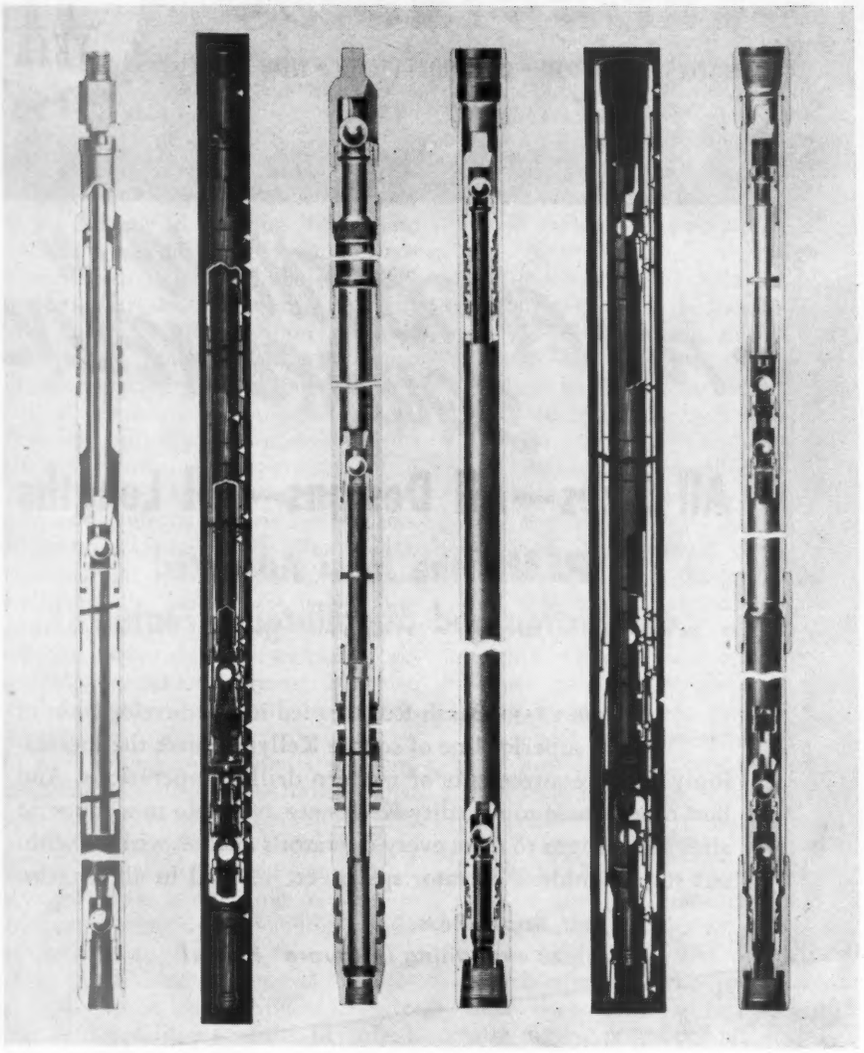

FIG. 5. Modern pumps, illustrating API types and one with double ball valves: (l to r) rod-type, stationary full barrel with top holddown; rod-type, stationary liner barrel with bottom holddown; rod-type, traveling full barrel; tubing-type, full barrel; tubing-type, liner barrel with extension; and a tubing-type, full barrel pump with extension and with double ball valves.

limited to special well conditions.

The hardest materials offered so far for bottomhole barrels and plungers are the boron-iron castings. They can be of nickel or chromium alloy. This unusual type of casting air-hardens to about 60 Rockwell "C" hardness. It obtains high hardness without additional heat treating. As it cannot be machined, it must be ground or honed. The coefficient of friction of boron-iron is extremely low. This is an additional benefit for its use in pump construction. The corrosion resistance of boron-iron is excellent except that the chromium alloy should not be used in a hydrogen sulfide environment. These alloys, as castings, offer excellent resistance to abrasion and, while their costs are high, their use may be justified by results in wells where rapid wear occurs.

The boron-irons are available as inlays in steel jackets of full barrel tubes

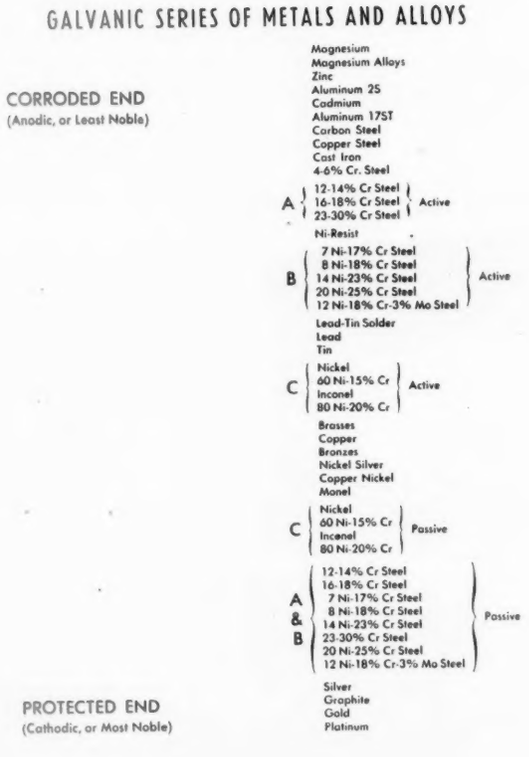

FIG. 6. Galvanic corrosion table.

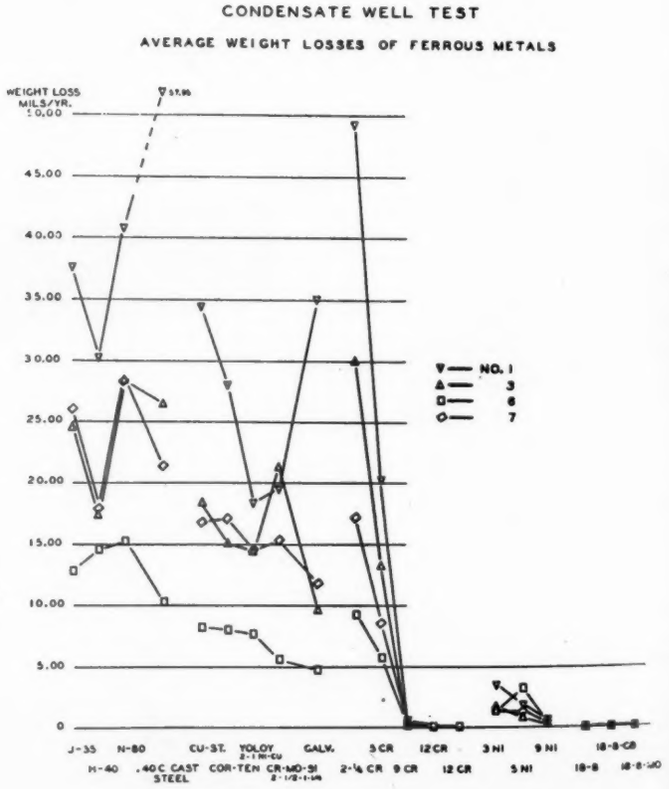

FIG. 7. Carbon dioxide corrosion test.

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and as sectional liners for use with jacket type construction. The material is used in both one piece and sectional type plungers that can be used in barrels of the same material.

Corrosion

The greatest expense to the oil industry is the constant struggle against "down the hole" corrosion. It attacks casing, tubing, sucker rods, and pumps. Many companies have established large laboratories that devote most of their time to seeking solutions to the corrosion problems of producing wells.

Fig. 6 covers the galvanic series of materials and varies only slightly from the often published electromotive series. The latter indicates which two materials will create the highest voltage, when used together in an electrolyte, such as in a battery. The galvanic series is arranged to show which materials lost weight by corrosive destruction rather than the voltage produced. Materials close together in the series should be used whenever possible. All materials should be as near alike as possible, because the fundamental law of corrosion control states: "All parts used together in a corrosive media should be of the same material throughout or closely associated in the galvanic table." One of the phenomena of the table is the fact that some materials take both an active and a passive position in the galvanic scale. Although, research concerning this is underway, no exact reason has yet been ascertained. This explanation accounts for the rapid deterioration of some parts containing chromium or chromium plating when these parts take an active position. Experiments are necessary to determine whether they are suitable for use in a given well.

It was formerly a common practice to send salt water samples from producing wells to the laboratory for analysis. No correlation between such analyses and corrosive conditions resulted, however, from such procedure. It is now generally accepted that the free gases, which escape from the sample when it is taken, are the real offenders, particularly when in the presence of water containing some natural salt. Without going into the many chemical reactions that can occur in a well, it suffices to say that hydrogen sulfide and carbon dioxide are, in the majority of cases, the offenders.

Hydrogen sulfide is usually indicated by a large number of small pits in steel parts. These pits greatly lower the strength of the material and cause early fatigue failure.

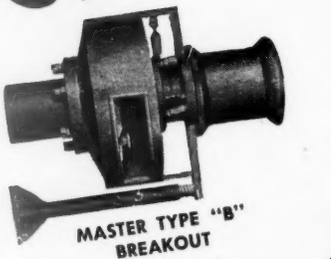
Carbon dioxide causes the so-called "ring worm", or large holes in local sections, where a dissimilar metal of higher resistance is near at hand. This type of corrosion is often concentrated at one point, or a few points, in a pump or sucker rod string.

Oxygen is not normally present in a well unless it was put there through water injection, air lift, or water flooding. It aggravates all types of corrosion and should be avoided by using closed water systems and any other methods at hand.

It is not possible to avoid all corrosion by the use of special materials, and, where "bad wells" occur, it is suggested that some form of inhibitor be used. Such inhibitors should protect not only the rods and pumps but also the tubing and casing. Certain inhibitors may react with the formations to cause plugging and expensive clean-out operations, so their use should be discussed with experts on such matters before using them.

Fig. 7 covers a test on some of the most corrosive distillate wells along the Gulf Coast where the offender has been identified as carbon dioxide gas. Of the readily available commercial materials, 3½ per cent nickel steel appears to offer the best approach to this corrosion problem. This material has also been satisfactory in all but

FOR SPEED



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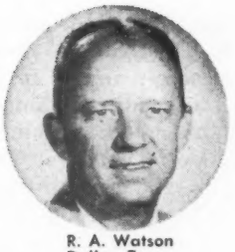
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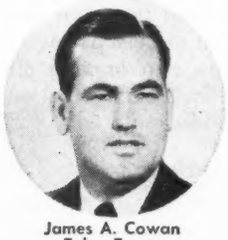
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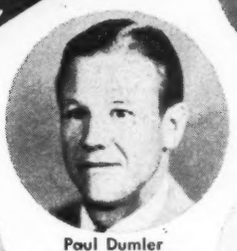
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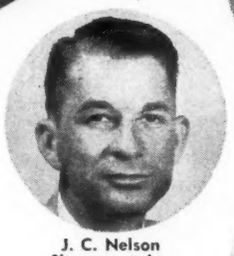
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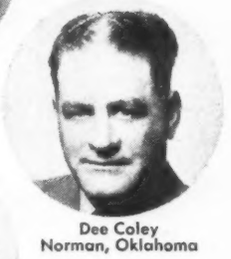
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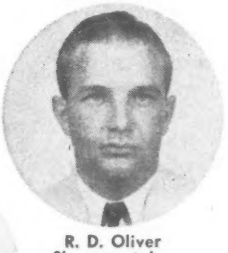
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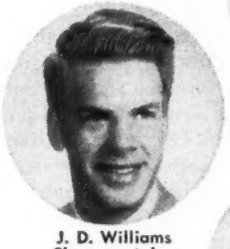
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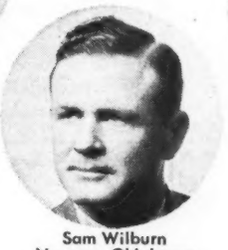
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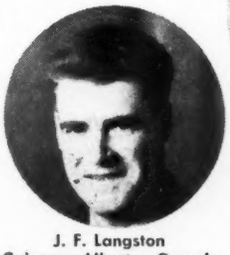
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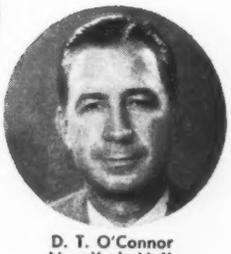

D. T. O'Connor
New York, N. Y.

the worst hydrogen sulfide wells. Its use, therefore, can be considered practical in many of the corrosive wells as it is readily obtainable in tubes and bars, and in machines as well. As this material can be heat treated for strength, it can be used in cage bars, in sectional tubes, etc. It is obtainable in sucker rods and castings suitable for hardening.

Impact

Impact occurs upon reversals of pumping motion where the fluid loads are transferred from the standing valve to the traveling valve and vice versa. Castings and sectional liner type pumps are less able to withstand impact than forgings and one piece barrel type pumps. If breakage by impact becomes your problem, we would suggest using smaller pumps and longer and slower strokes. Care should be used in spacing the pumps to avoid pounding down or up at the pump. "Pumping off" should be avoided, and speeds above 200 ft per minute at the polished rod should be reduced. It is obvious that the life of all subsurface equipment, especially balls, seats and cages, will be reduced by high pump speeds.

Some ball and seat trouble may be avoided by using double balls and seats in traveling and standing valves.

Pump parts, especially open cages, are of necessity, low in factors of safety. There just is not enough space to make such parts substantial in size. Care must be used in making up joints where these heavily loaded parts are used. Proper wrenches will help avoid damage. Blind cages can often be used to provide greater strength, eliminating the ball from the open cage and using the cage merely as an adapter.

Tight fits in cup or ring plungers will add greatly to the loads that parts must carry and should be avoided.

Sucker Rods

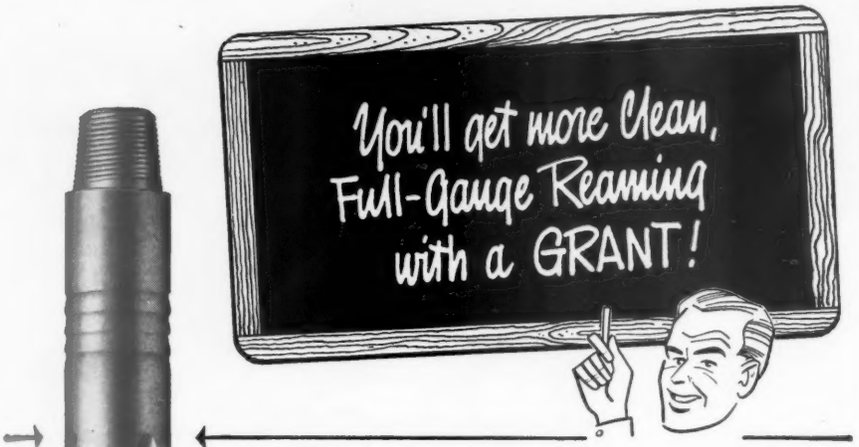
There is probably no item of equipment used in the production of oil that has advanced as greatly in recent years as have sucker rods.

Since the first one piece steel sucker rod was produced, there has been a steady and extensive search for better steels, better heat treating, better threading, better gaging, straightening, cleaning, coating, handling, and storage of this product. A rod, of necessity, has a very low factor of safety and, generally speaking, does an outstanding job. Behind sucker rods are the laboratories with their chemical and physical checking equipment, fatigue testing machines, thread comparators, and equipment such as the photo-micrograph camera illustrated in Fig. 8.

It is not possible to class the many grades of rods with their wide variety of heat treatments as we now class casing and tubing, and the industry has benefited greatly by avoiding such standardization. This allows the manufacturer to build for quality and service rather than try to build a given grade at the lowest possible cost.

Three grades of commercial steel have proved to be satisfactory for the general run of sucker rods. The first of these grades is carbon manganese in which the carbon ranges from .35 to .45 per cent and manganese is about 1.35 per cent. The rods are usually normalized after upsetting. These rods have little corrosion resistance and are generally used in wells where corrosion does not occur. They are suitable for loads from 25,000 to 30,000 psi, the latter rating being advisable only at the slower speeds and longer strokes.

Nickel molybdenum steels of the SAE 4600 series having a carbon content of .15 to .21, manganese from .55 to .90, and with about .24 to .28 molybdenum and 1.83 per cent nickel comprise this group. These rods can be normalized and tempered or quenched and tempered. They are resistant to mild corrosion and have more fatigue resistance than the man-



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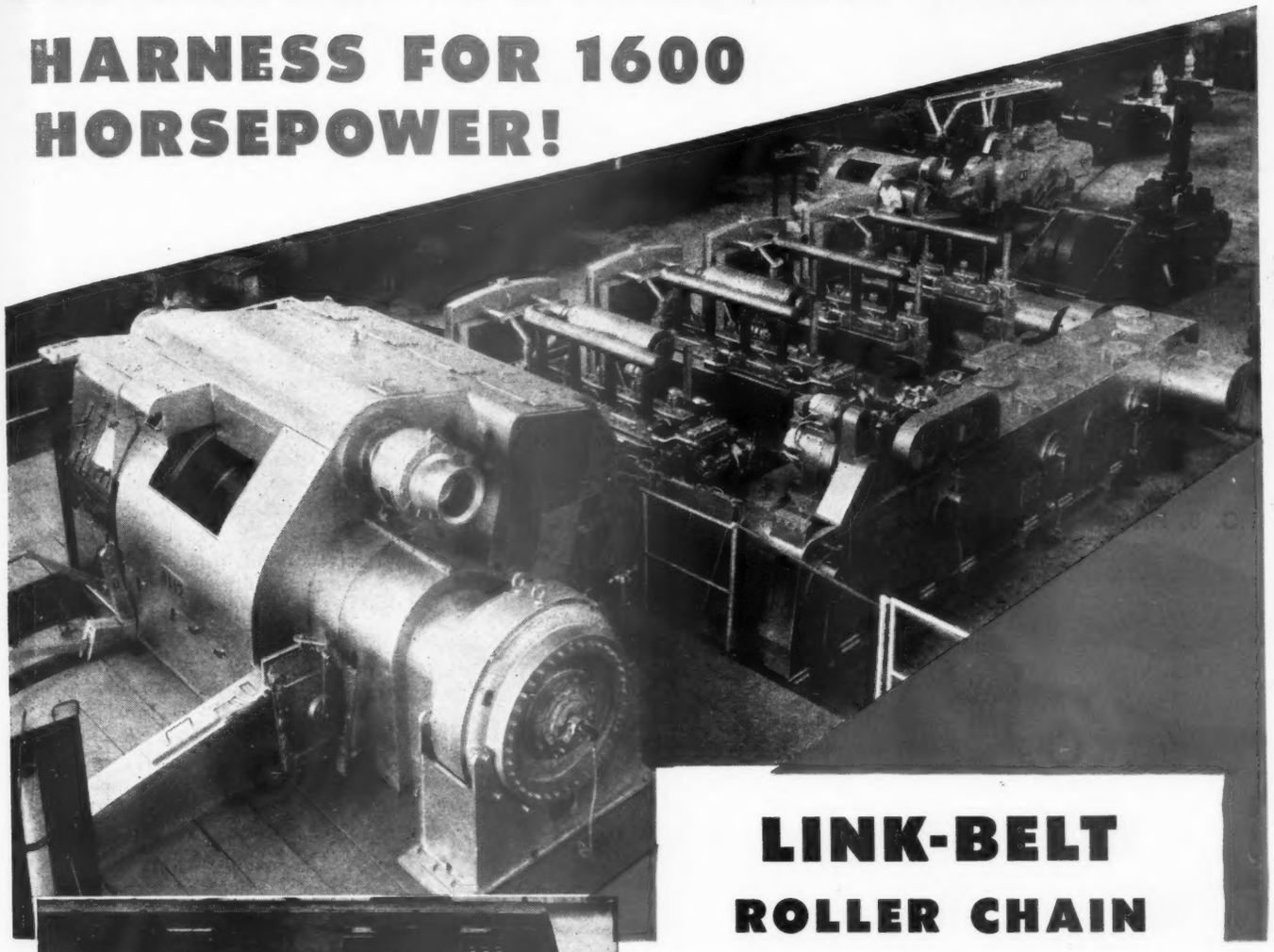

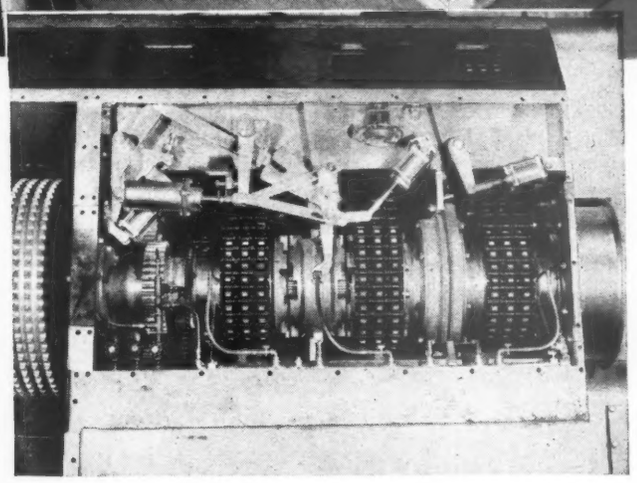

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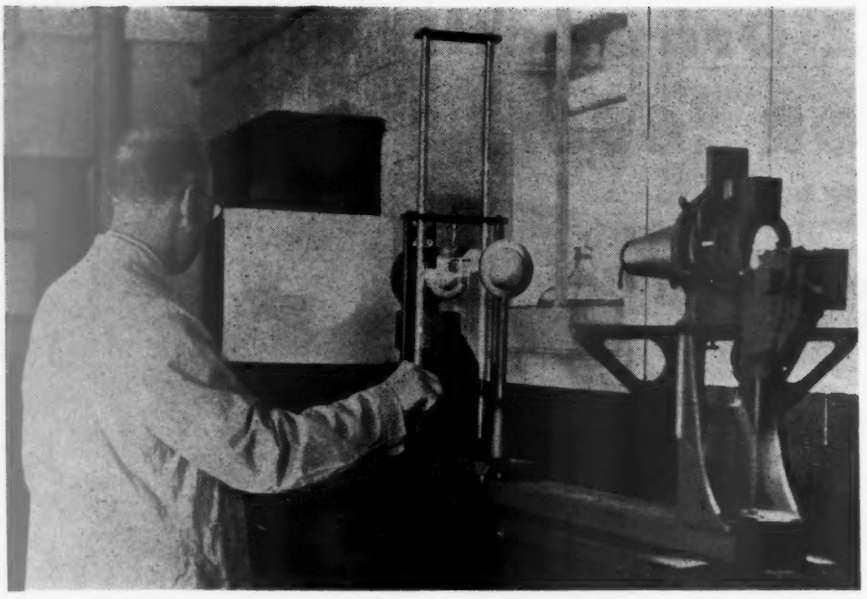


FIG. 8. Photo elastic study of sucker rod threading.

FIG. 9. Proper care in handling sucker rods in field.

ganese steels. As a general rule, those of lower carbon have higher corrosion resistance. As carbon content normally governs strength, the quenching operation can be used to obtain high strength while avoiding corrosion by the use of low carbon. These rods can be used from 30,000 to 35,000 psi loadings, and it is again suggested that loadings be reduced where high speed reversals occur or as corrosion increases.

The third class of commercial steels generally used in sucker rod manufacture is the high nickel-moly SAE 4800 series containing 3½ per cent nickel, .35 to .50 manganese, .25 molybdenum, and .10 to .18 per cent carbon. Because of the higher nickel and lower carbon, these rods are generally more resistant to corrosion and have better physical properties, including greater fatigue resistance. They are usually normalized and tempered. By the addition of copper, this material can be hardened by precipitation. These rods are generally recommended for about the same loads as the SAE 4600 series previously mentioned, however, they have better corrosion resistance.

For maximum corrosion resistance in hydrogen sulfide there is available a quenched and tempered 3½ per cent nickel steel rod containing molybdenum and with very low carbon and manganese. This rod uses a maximum of .05 carbon and .25 manganese. Owing to the low carbon and the high nickel content, this rod has excellent hydrogen sulfide corrosion resistance. Strength is added by quenching, and the rod finds its service in loadings of about 25,000 to 27,000 psi in extreme sulfide corrosion. High nickel steels contain .10 to .15 carbon, .50 to .81 manganese, and .21 to .175 chromium, in addition to normal molybdenum when normalized and tempered, and have high strength and some hydrogen sulfide corrosion resistance. These rods are usually offered for higher loadings in deep wells where little corrosion is encountered. High nickel steel without the chromium content and with normal carbon and manganese, in addition to molybdenum, can be tempered for the highest of load carrying ability in deep long stroke applications. Such a rod is recommended to 40,000 psi loadings where corrosion conditions are mild.

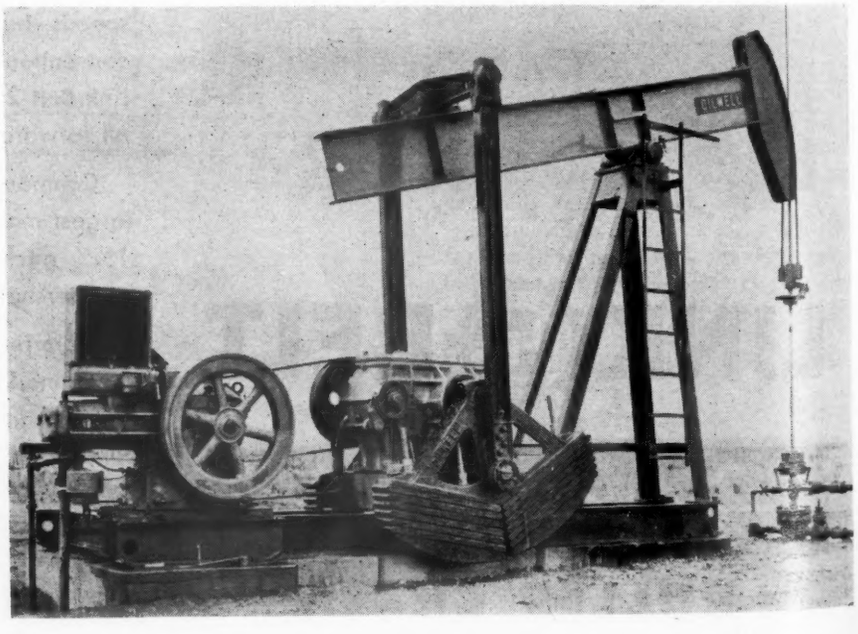
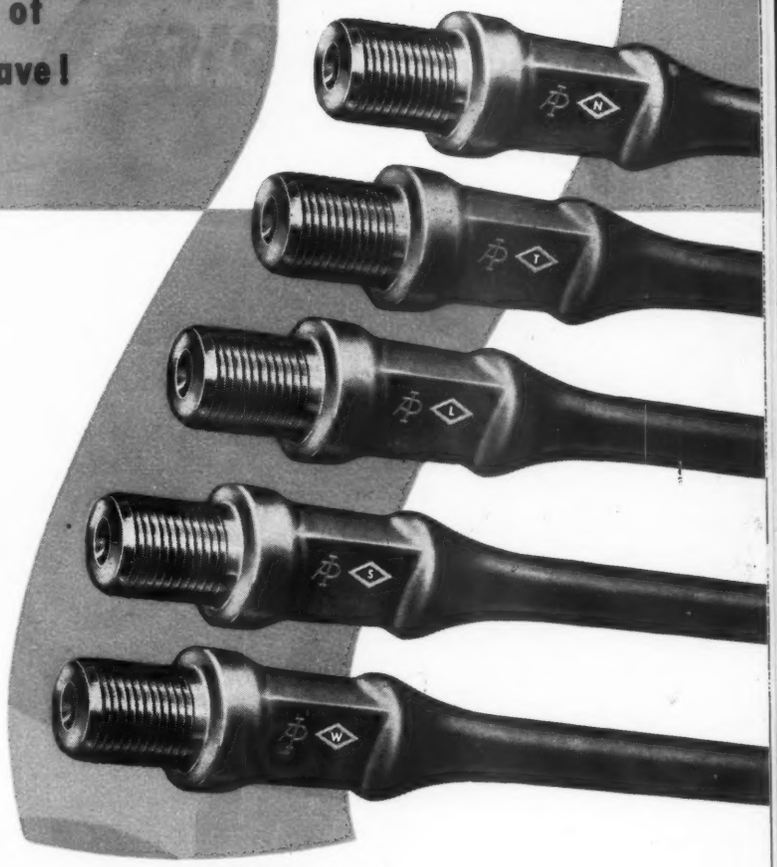


FIG. 10. Modern pumping unit design. Note tall sampson post for longer stroke, safety ladder and remote lubrication lines.

Why 5 Grades of "Oilwell" SUCKER RODS?

TO GIVE YOU the utmost in rod-service-per-dollar-invested, no matter which of the 5 types of well conditions you have!



1. NORMAL OPERATING CONDITIONS

Grade "N"—A uniform quality carbon-manganese steel rod, fully normalized after forging to neutralize end-stresses of forging—**proven for years in non-corrosive operations.**

2. MILD CORROSION CONDITIONS

Grade "T"—A modified "4615" controlled open-hearth nickel-molybdenum alloy steel rod—quenched, tempered and stretch-straightened while hot to give good resistance to corrosion and permit above-average loading in most wells—**the industry's outstanding all-purpose rod.**

3. CARBON DIOXIDE CONDITIONS

Grade "L"—A special analysis controlled fine-grain rod of alloy steel, normalized and tempered to be most resistant to this particular form of corrosive action. **This rod has exceptional fatigue resistance.**

4. HYDROGEN SULPHIDE CONDITIONS

Grade "S"—A special electric-furnace low-metalloid steel rod of high nickel-molybdenum content, developed especially to withstand severe sulphide corrosive action — **extra low carbon resists sulphide, but liquid-quenching gives toughness and strength.**

5. HEAVIEST LOAD CONDITIONS

Grade "W"—A special analysis high-alloy steel rod that is quenched, tempered, stretch-straightened while hot and proof-tested to achieve maximum load-carrying capacity — **setting new service records at great depth or for use where tubing size is limited.**

"Oilwell's" 5 grades enable you to buy the rods best suited for each well condition. When chemical composition and physical properties of rods correspond with well requirements . . . **you save both time and money.**

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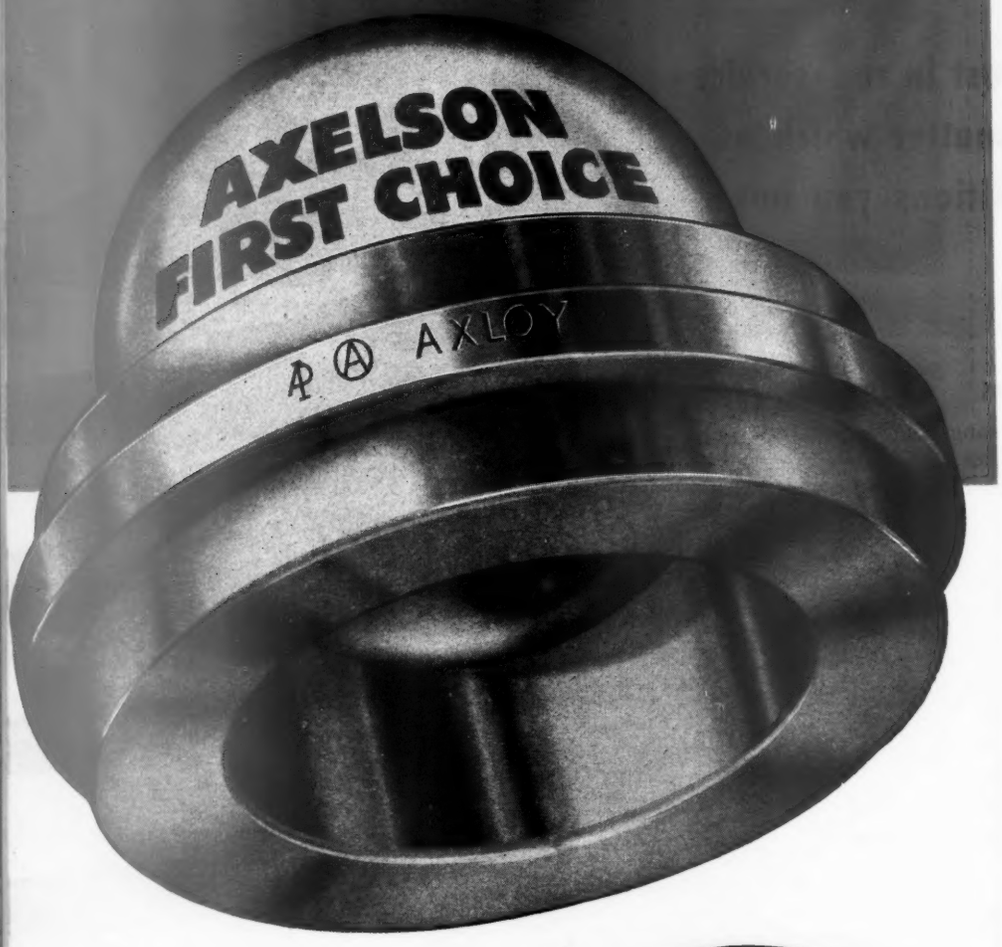

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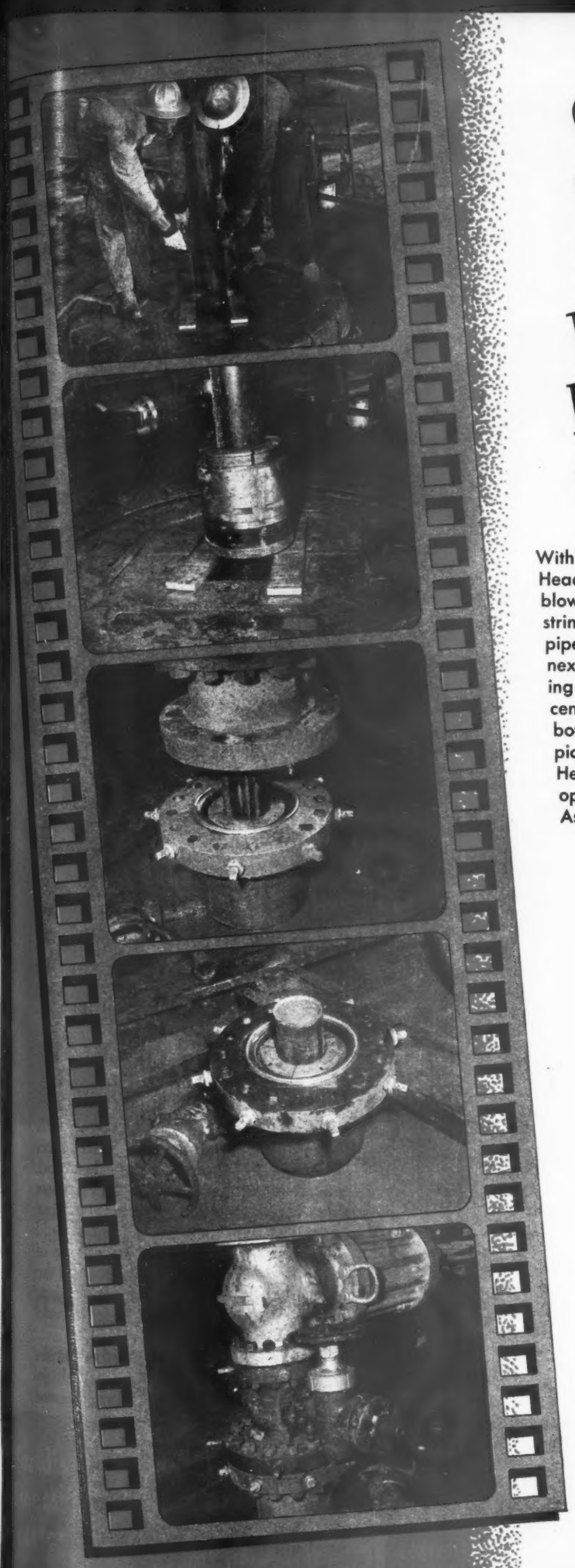
There is another class of material containing .35 to .36 carbon, .60 to .75 manganese, .65 to .150 nickel, .40 to .75 chromium and little, if any, molybdenum available for sucker rod manufacture. One manufacturer normalizes the lower alloy content. These rods have proved satisfactory when exposed to carbon dioxide corrosion more because of their grain structure rather than their physical properties. These rods should not be used in hydrogen sulfide owing to their chromium content, however, they are satisfactory for use in salt water. Loads can be in the vicinity of 30,000 to 35,000 psi except where high speeds, short strokes and severe carbon dioxide corrosion occurs.

Care and use are as important as material in obtaining service from sucker rods. Proper tools, good handling methods (Fig. 9), good housekeeping, are often as important as the load in securing long life from sucker rods. It is suggested that care be used in selecting the right size and material for each well. A careful study of the well should be made before such selection. It is well to remember that theoretical well loads are based on ideal conditions. The flow lines to the tanks may cause many extra pounds of load, if such lines are long or exposed to cold, or have several right angle bends, or if they are small in diameter. Stuffing boxes, when run excessively tight, can add many pounds to the load which gears and prime movers must carry. Tight plungers and crooked holes can greatly add to the burden the equipment carries. Most of us are familiar with the problem that paraffin causes wherever it tends to form in the tubing. It is, therefore, suggested that reasonable factors of safety in loading sucker rods and production equipment will avoid many an extra pulling job and costly repair.

In summarizing the selection of sucker rods, it is suggested that the well conditions be carefully analyzed and that a grade and size of rod suitable to the problem be purchased. In selecting the rods, it is recommended that a rod be purchased that has been manufactured to API specifications. Sucker rod couplings should have the faces ground after hardening. A "ground" coupling should be ground on the OD only and not on the vital faces at each end.

Check both ends at the upset for a full flow of metal in the dies, without folds or flaws. Avoid rods having metal base paint as a protective coating. Metals can cause local battery action in a brine solution. Non-metallic base coatings are to be preferred. Check rods for cuts, bends or similar



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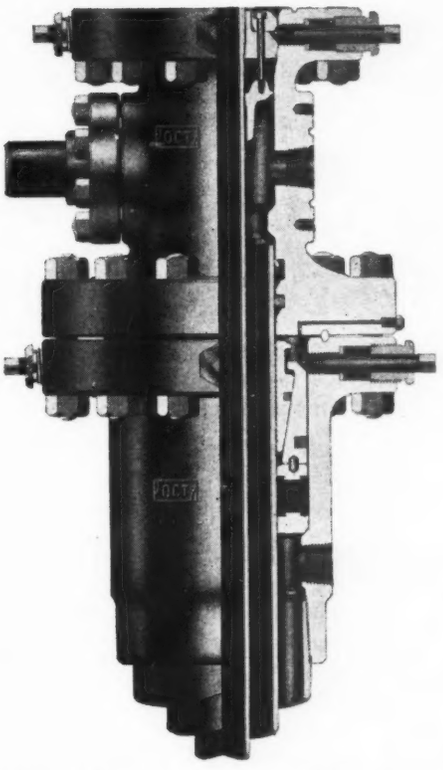

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abuse before running. Such rods will be the first to fail and should be junked or, at best, used near the bottom of the string where loads are lightest.

Pumping Units

As a motion picture, "Gears . . . and Oil", will be presented at the close of this paper, the remarks concerning pumping units will be brief. There is a trend toward smaller pumps and longer strokes throughout the industry, and this trend is based on sound reasoning. Pumping units designed for this type of service will have higher samson posts and longer pitmans. Longer pitmans will result in in less angularity between the pitman and the beam and, consequently, lower peak loadings on the gears. The smaller-sized units may continue to be preferred with weights on the beams, plain cranks and stroke adjustment by moving the upper pitman bearing along the beam. Rotary type cranks (Fig. 10) may be preferred in the larger units, because of the accessibility of the auxiliary weights for adjustment. Double reduction gears have proved satisfactory for all but the slowest of prime movers. There is a trend towards the use of larger prime movers, which should be rated to care for the peak loads rather than average conditions, if they are to render long and trouble-free service. Roller bearings of the adjustable type should give long life, low friction, and easy replacement. Modern pumping units have considerably greater interchangeability, resulting in lower costs and more adaptability. They are equipped with safety ladders, remote lubrication lines, and other accessories for safer lubrication and ease of adjustment.

Conclusion

Summarizing this discussion, it is suggested that the wells and their problems be thoroughly understood, and to do this it is necessary to use the proper instruments for recording factual conditions. Equipment should be selected with care and should be of ample size and suitable quality for the well in question. Good housekeeping, making leases clean and safe, should pay dividends.

The priceless energies inherent in reservoirs should be conserved in every way possible. Management should insist that equipment be properly installed, lubricated, serviced, and correctly operated.

The producing job with the best of pumping units, sucker rods and bottom hole pumps is never easy, but it need not be so difficult, if we can stay "on the beam." * * *

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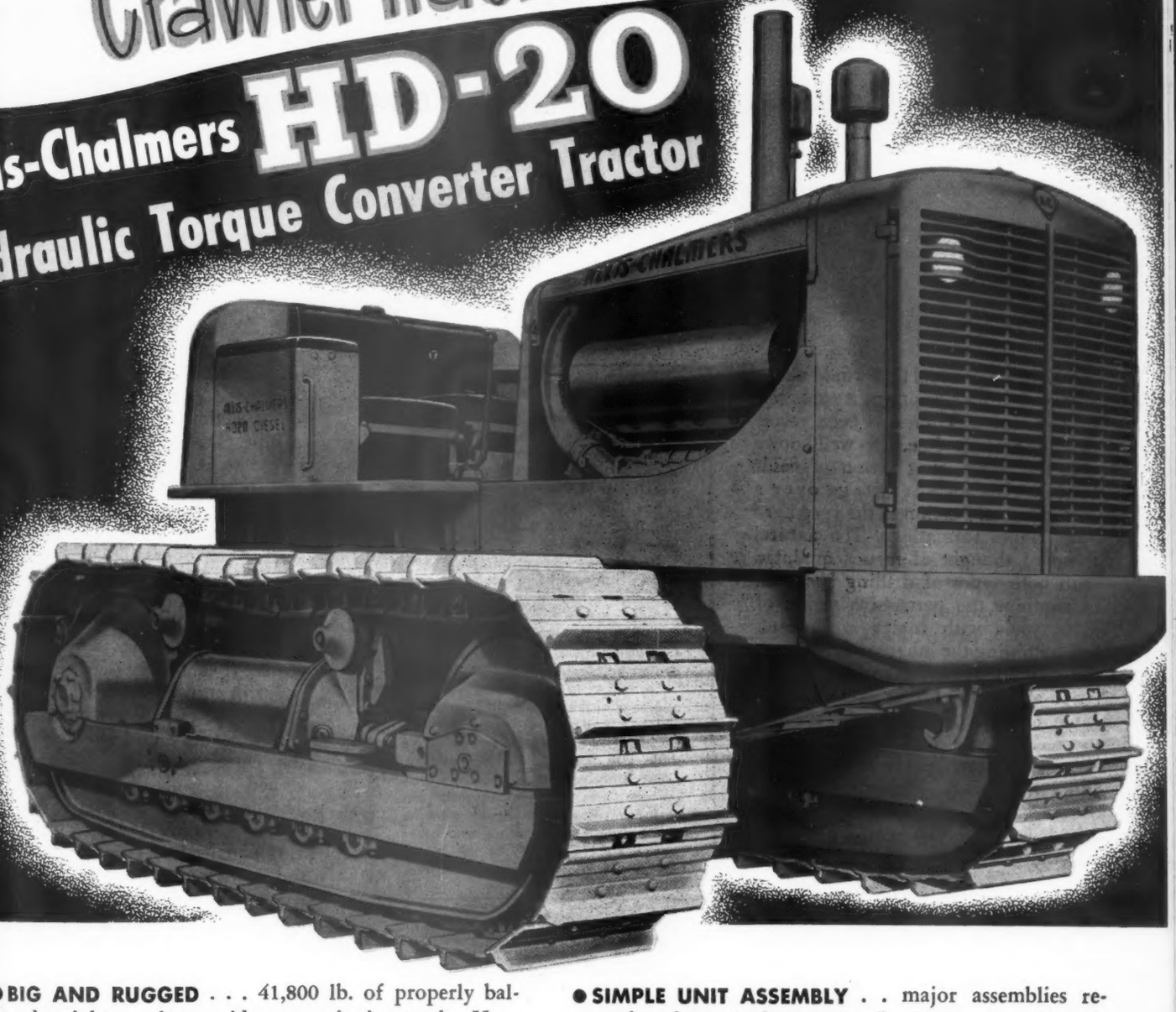

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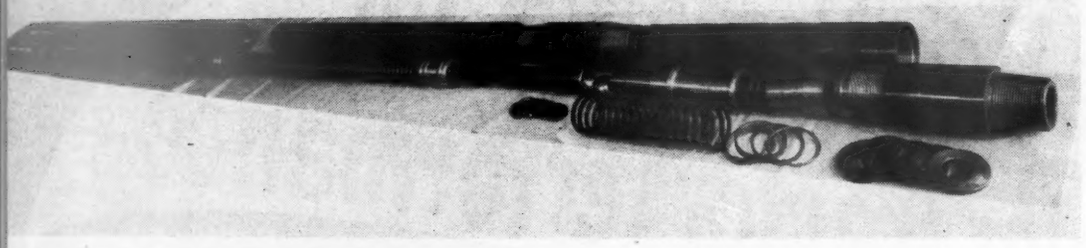


Latest type Bassinger drill is 7¼ in. OD, 28 ft long, and hammer weighs 750 lb. The parts are laid out in their relative positions.

P 426.

The Bassinger Rotary Percussion Drill*

ROBINSON BROWN

THE need for a tool that would add to rotary drilling equipment a cable tool or percussive action has been recognized for a long time. It is well known that the hammering action of cable tools holds an advantage over a straight rotary action in the very hard and friable formations. The natural trend of thought of men acquainted with both types of drilling has been to combine the percussive action of cable tools with rotary equipment, thus retaining the inherent advantages of continuous rotation and fluid circulation and adding the impact action of cable tools. This paper will attempt to present some of the history of rotary percussion development, a discussion of the Bassinger drill, and a comparison of results obtained with this drill against conventional rotary drilling.

The Author

Robinson Brown, supervisor of engineering design at the Southwest Research Institute of San Antonio, Texas, received his BS degree from the University of Texas. He attended the U.S.N. Ordnance School at Washington, D.C., and is a member of the U.S. Naval Reserve.

He has made a special study of subsurface rotary drilling equipment and abrasion resistance, and has had 20 patents applied for by his employers. He was employed by Reed Roller Bit Company from 1936 to 1941 as a draftsman, designer, and engineer.

From 1941 to 1944, Brown was chief engineer of the oil tool division of the Chicago Pneumatic Tool Company. During 1944 to 1946, he was on active duty with the U.S. Naval Reserve, supervising contract work on M-4 tank parts; and as officer-in-charge of aircraft firing line, experimental machine shop, aircraft rocket firing, and other development problems at the Naval Officer's Training School in California.

History

To our knowledge, the first record of a well drilled with rotary equipment in this country was at Spindletop in 1901. Prior to this, the method was in use in Europe and thinking far enough advanced to recognize the advantages of combining the two methods. It is rather amazing to realize that as far back as 1887, and perhaps before, the art of the rotary percussion method was well thought out. This fact is evidenced by a patent issued in England on August 16, 1887, and filed in the United States on October 26, 1887, by Freidrich Buschmann of Germany. This patent No. 402,229 was issued in the United States April 30, 1889, and the following is quoted directly from the specifications.

"Be it known that I, Freidrich Buschmann, a subject of the Emperor of Germany, residing at Heilbronn, Germany, have invented a certain new and useful improvement in Rock Drills, of which the following is a specification.

"My improvement relates to rock drills in which the boring tool is forced downwardly and its lifting produced by a column of water forced into and out of the bore hole.

"The pipe (k) is supported from a link (R), to which is secured a rope or cable (R)′, by which the pipe (k) and boring apparatus may be lifted and lowered. The pipe (k) is coupled near its upper end to a coupling piece (k)′ by a swivel connection so that it may be rotated therein. The pipe (k) is rectangular in cross-section and is coupled to a pipe (i). The pipe (i) has secured to it, near its lower end, the boring apparatus proper. The pipes (k), (i), and the boring apparatus may all be turned during the operation of boring.

"Water is forced downwardly through the pipes (k) and (k)′ into the plunger cylinder, forcing the chisel down to make its stroke. If suction be then applied, it, with the assistance of the spring (d), will again raise the chisel. A very rapid operation of the chisel may thus be occasioned."

This is only a small part of the description forming the specifications of this patent; but, from it and Figs. 1 and 2, we may see that Buschmann had not only conceived the basic elements of a rotary drilling rig, but had also anticipated a percussion tool to go with the rotary equipment.

In Fig. 1 we see many of the above ground essential elements of a rotary rig, as follows: Pump, standpipe, rotary hose, lines, bails, and swivel.

Although Buschmann describes the rotary table and hoisting lines being driven by manpower, it takes no great imagination to add mechanical power to these two elements.

In Fig. 2 we can see the balance of the above ground elements and all the principal subsurface elements of a rotary rig, plus those of a percussion drill, namely: Kelly, rotary table, drill pipe, tool joint, drill case, or outer barrel, drill hammer, return spring, and bit.

In this patent, the equipment as described necessitates applying from

*Presented at the September 25, 1950, Annual Meeting of the Petroleum Division of the ASME in New Orleans, Louisiana.

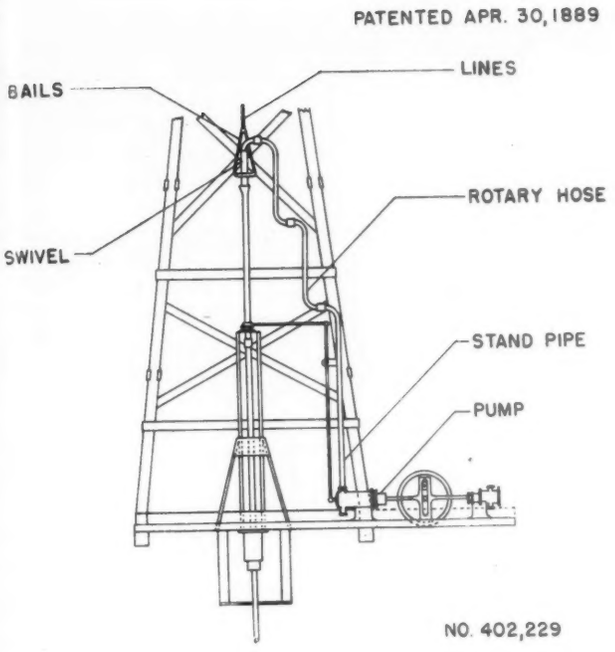


FIG. 1

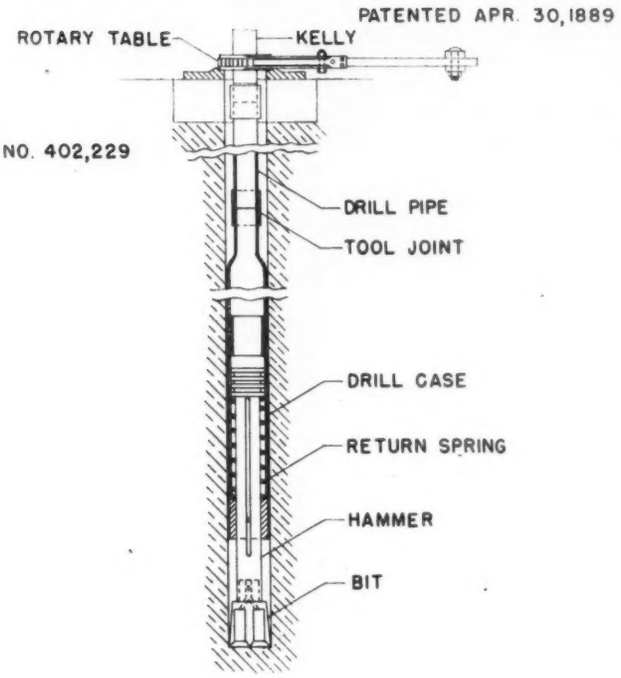


FIG. 2

the surface a continuously varying pressure that, considering the depths of wells drilled today. would. of course, be impractical; however, it must be conceded that this inventor certainly had an insight into the future.

To make a fluid actuated percussion drill practical, it is necessary that it operate on fluid power that is undirectional and supplied at a constant pressure at the surface. The earliest patent that we have uncovered on a drill that contains the elements to accomplish this is 699,273, filed in September 1900 and issued in May 1902 to Waclaw Wolski of Austria, (see Fig. 3).

Wolski describes his fluid driven percussion drill, and it is of interest to note that he incorporates an accumulator at the top of a heavy section above the drill. In present day terms, his accumulator is shown in the top of the uppermost drill collar. The important part of this patent is summed up in Claim No. 2. which reads as follows:

> "In a boring apparatus, a cylinder, a reciprocable tool, a bypass, hollow bore rods to send water to said cylinder and bypass, a valve controlling the bypass automatically closed by the force of the moving water to cause the inertia of the moving column of water to drive the tool and a suitably located air chamber to prevent the force being translated to the bore rods, substantially as described."

Fig. 3, which is an exact copy of Fig. 1 of the patent, shows the elements of the drill, which may be defined in current language as: Drill pipe, accumulator, drill collar, control assembly, piston, case, return spring, hammer, and bit.

In operation, this drill was intended to function on the water hammer principle. Fluid being pumped down through the pipe reaches a high enough velocity to overcome the control spring, thus closing the control valve and shutting the ports through the top of the hammer piston. When these ports are closed, the inertia of the column of water moving down the pipe acts on the piston to overcome the force of the hammer spring and drive the bit down into the formation being drilled. This drill, as shown, would not function because no means is provided to lift the valve from its seat on top of the piston and thus allow the fluid to exhaust during the last part of the power stroke of the hammer. By a simple change, however, this drill would then become operable; the valve guide is secured to the case instead of to the piston, thus allowing the control spring to go solid to stop the valve as the hammer continues down on its own inertia.

There have been many patents issued on fluid-actuated percussion drills in which the reciprocation of the hammer is accomplished in several different ways. These methods of causing reciprocation of the hammer may be generally classified as:

1. Hammer driven down by the fluid and spring returned.
2. Hammer forced down by a spring and fluid returned.
3. Hammer driven both ways by the fluid.
4. Hammer reciprocated by eccentric means driven by a turbine or rotary motor.
5. Hammer reciprocated by a cable or rod from the surface.
6. Hammer reciprocated by a reverse jaw clutch means, whereby one member is held stationary while the other rotates, causing the teeth to ride up onto their crests and then fall into the roots to produce a jarring action. This same principle may be accomplished with an interrupted thread.
7. The method in which the entire drill stem is raised and lowered, the drill stem thus becoming the hammer.

A much broader classification but one that distinguishes between two lines of thought in rotary percussion drilling is the division of all methods into two groups—group No. 1 being that in which the bit is carried on the hammer and, therefore, moves up and down in the hole, and group No. 2 being that in which the bit is preloaded onto the bottom of the hole and carried on the lower end of an anvil, the upper end of which is struck successive blows by the hammer.

As this paper is concerned principally with a drill that comes under group two, method one, wherein the

bit is carried on an anvil and the hammer is driven down by the fluid and returned by a spring, patent No. 1,861,042 is of interest. This patent issued to J. A. Zublin in 1932 describes a percussion drill that comes within the group and method under discussion.

Fig. 4 shows the preferred embodiment of Mr. Zublin's invention, and the parts may be identified as: The drill pipe, case, control assembly, control spring, control valve, hammer piston, hammer return spring, hammer, lower spring seat, anvil, and the bit.

The hammer spring plus the rebound off of the anvil forces the hammer to its uppermost position at which point the control valve seats, closing the port through the piston and causing the pump pressure as well as the inertia of the fluid column to act on the piston to drive it down. The differential pressure across the valve holds it seated until the hammer is near the bottom of its stroke. At this point, the rod extended from the lower end of the valve strikes the anvil to unseat the valve, allowing it to return by the force of the control spring to its original position. The fluid above the valve is now free to exhaust while the hammer continues under its own momentum until it strikes the anvil and rebounds to repeat the cycle.

The author has in his files 69 patents related directly to the subject and constituting only a cross section of all patents issued. It may seem strange, with so many patents issued relating to rotary percussion drills, that prior to March of this year, none of them, to our knowledge, had been developed to a stage where a commercial tool was available to the oil industry. This can be partially explained by the rather exacting requirements of a good percussion drill, the necessity of perserverance on the part of the developer, and the large financial burden connected with such a development. Fortunately, the perserverance was supplied by the untiring efforts of Ross Bassinger, and the financial burden was carried due to the farsightedness of the Shell Oil Company, Tom Slick, through the Institute of Inventive Research, and J. M. Hewgley.

During a three-year period of development, the engineering on the drill has been done by Bassinger, the Shell Oil Company, and the Southwest Research Institute. Although some parallel work has been carried on in connection with bits, the main effort before January of this year was directed toward the perfection of the drill, or mud-engine proper. These efforts have resulted in a drill which, by tests over the past few months, may be considered a dependable piece of drilling equipment. Continuous periods of on-bottom operation exceeding 40 hr have been accomplished and a few runs have been recorded in excess of 50 hr.

Principle of Bassinger Drill

The Bassinger drill operates on the principle in which the bit is carried on the lower end of an anvil and the hammer is returned, after its power stroke, by the force of a spring. To our knowledge, a very valuable contribution to the art has been contributed by Bassinger in that he has provided means to allow the hammer to overtravel on its return or upward-stroke. From a practical standpoint, it seems to be absolutely necessary that this provision for overtravel be made, as any attempt to provide a solid stop to arrest the hammer on its return stroke creates terrific impact forces that tend to destroy the drill.

Fig. 5 shows diagrammatically the construction of an early model Bassinger drill. Seven of these were built, and drilling records were kept, covering a total footage of 13,822 ft.

The principal parts of the drill are shown in Fig. 5 and designated as: Control sleeve, control spring, control sleeve guide, piston, piston guide, case, hammer spring mandrel, hammer return spring, lower spring seat, hammer, hammer guide, anvil, anvil splines, and the bit.

This drill differs from other earlier drills, as shown in the patent literature, in that provision is made for the hammer to overtravel on its upward stroke and to stop only as the fluid pressure acting on the cross sectional area of the piston overcomes the inertia of the hammer and the upward force of the hammer springs.

Fig. 5 shows the drill in its point of operation when the hammer has just struck the anvil to deliver impact en-

FIG. 3

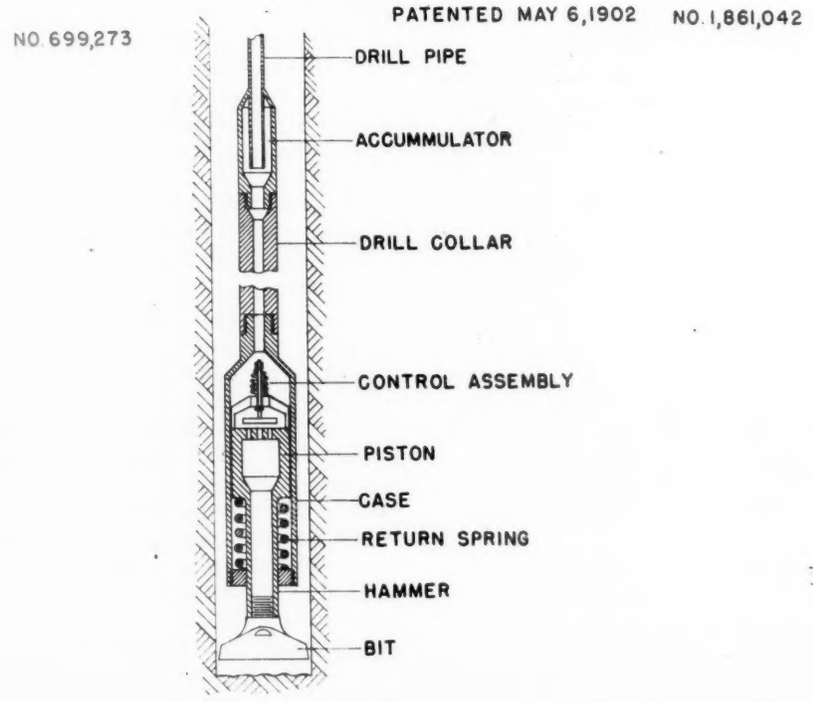
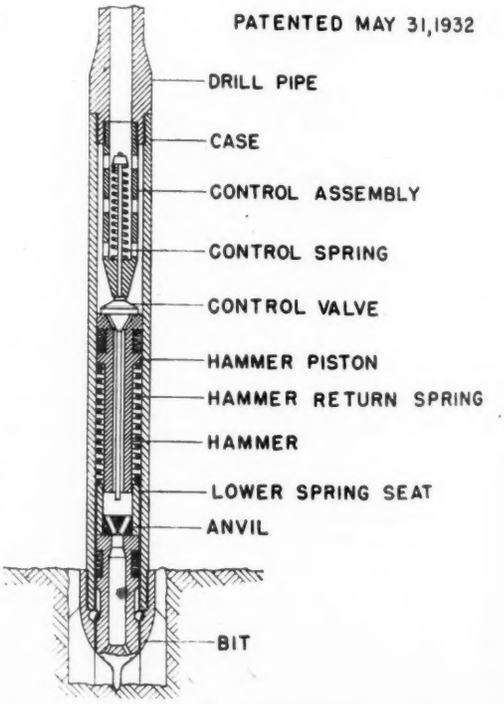
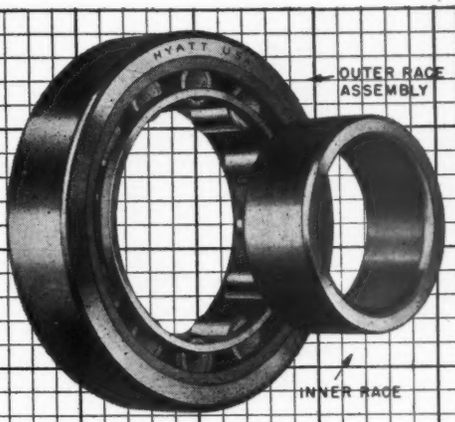
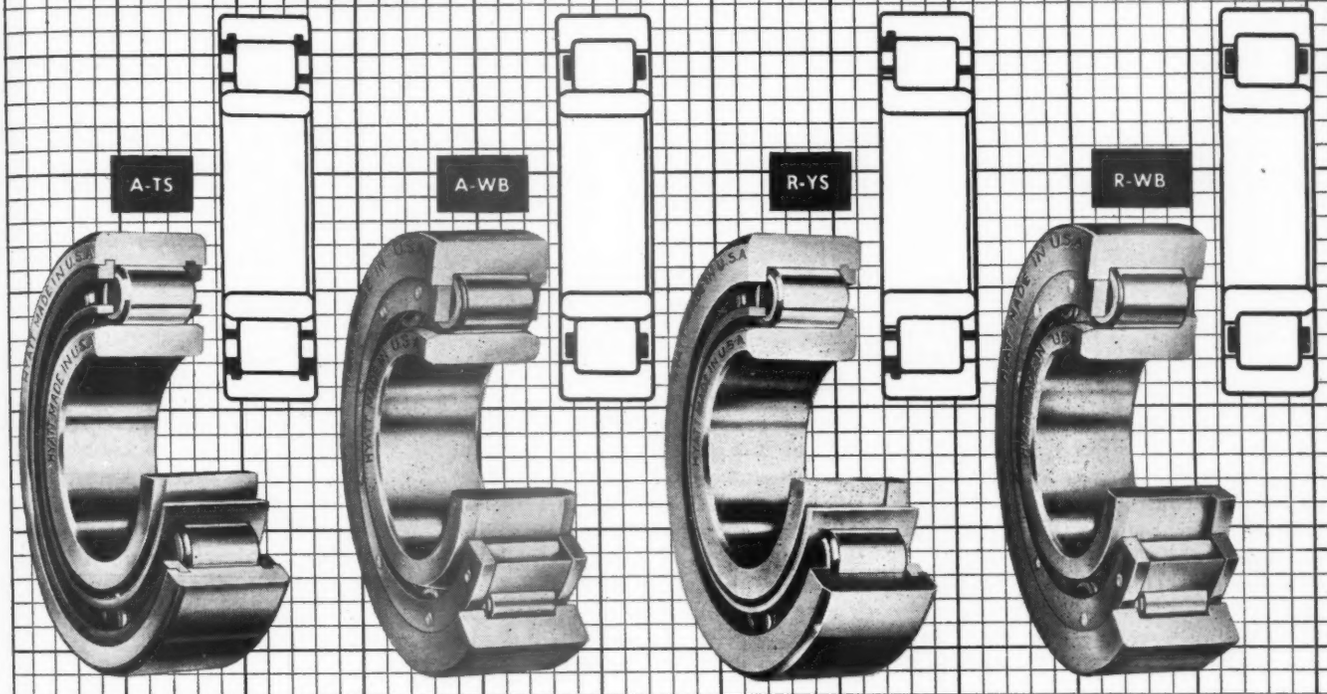


FIG. 4



For Separable Inner Race Bearings-- HYATT HY-LOADS





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HYATT ROLLER BEARINGS

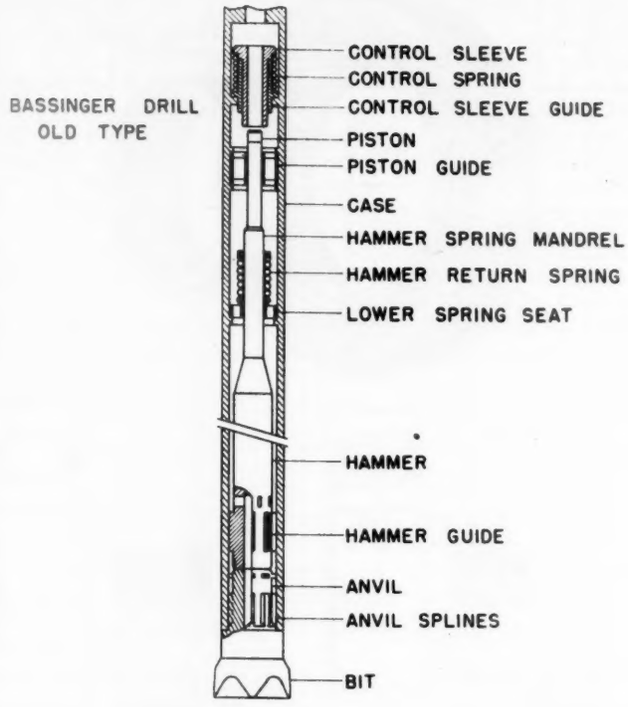


FIG. 5

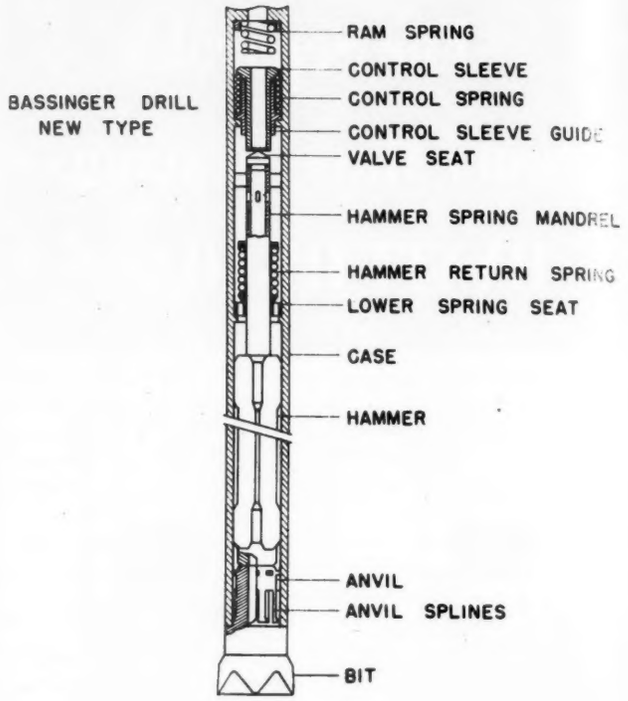


FIG. 6

ergy through the anvil and to the bit. At this point, the differential pressure which had existed across the sectional area of the control sleeve is released, and the control sleeve is returned by the force of its spring to its uppermost position. During this period, the drilling fluid is free to exhaust through the control sleeve, around the mandrel and hammer, and through the eyes of the bit. The rebound off of the anvil plus the force of the hammer return spring then drive the hammer upward until the piston again enters the lower end of the control sleeve. At this time, since the control sleeve is plugged with the piston on the inside and sealed on its outer diameter, a differential pressure is created across it and the sleeve immediately dives down to its lowermost position.

The control sleeve and piston have now blocked the flow of fluid causing the inertia of the fluid column plus the normal pressure build up of the pumps to act on the cross sectional area of the piston. The hammer continues its upstroke until its inertia plus the force of the hammer return spring are overcome by the force of the pressure across the piston. The hammer is then accelerated on its power stroke by the fluid pressure until it reaches its final velocity just as the top of the piston leaves the lower end of the control sleeve and immediately before the lower end of the hammer strikes the anvil to repeat the cycle.

A paper by P. L. Guarin and H. E. Arnold on the performance of the drill at this stage of its development was presented in November 1949, at the annual API meeting in Chicago. Thirteen tables of field results giving the comparison of rotary percussion and conventional rotary drilling over a wide range of formations and conditions were given. This data will not be repeated; however, the conclusions reached in this earlier paper are of interest and are quoted as follows:

> "Not enough experience has been obtained with the rotary percussion drilling method to warrant drawing any firm conclusions at this time as to the extent of its possible future application to hard-rock drilling.
>
> "When used with the special tri-cone percussion bit, it will drill hard friable formations containing chert (in any amount up to 100 per cent) faster than the best conventional methods and will drill at least twice as much footage per bit.
>
> "The percussion tool can be used to good advantage as an aid to the conventional rotary equipment where normal drilling progress is being seriously retarded due to inability to apply proper weight to the bit because of the crooked-hole conditions.
>
> "Much more study and experimentation, both in the laboratory and in the field, are needed to investigate critically what actually constitutes the best drilling action in various types of hard and medium-hard rocks, as it is believed such precise knowledge might well lead to the development of better percussion tools and to the development of more efficient bits for use with both conventional and rotary percussion drilling equipment."

Fig. 6 shows diagrammatically the latest development in the construction of the drill and one by which the strokes per minute have been increased from an average of 225 to an average of 800. The essential parts may be described as: Ram spring, control sleeve, control spring, control sleeve guide, valve seat, hammer spring mandrel, hammer return spring, lower spring seat, case, hammer, anvil, anvil splines, and bit.

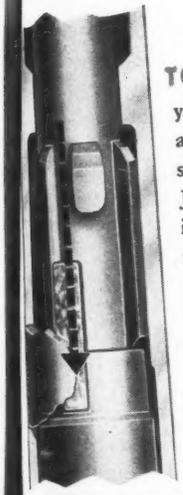
It will be noted that this construction differs from that shown in Fig. 5 in that a ram spring has been added, and the hammer piston replaced by a valve and seat. Contrary to the earlier model, the upper end of the hammer spring mandrel is no longer allowed to enter the control sleeve but now seats on the lower end of it.

In operation, when circulation is started, the control sleeve, which had been in its uppermost position with its top resting on the lower face of the ram spring, is forced down carrying the hammer down with it. When the control sleeve reaches its stop in the control sleeve guide, its downward movement is arrested and the hammer continues down, opening the valve

This is the tool that is revolutionizing drill string protection on today's wells!

The SHAFFER-WAGGENER BUMPER SAFETY JOINT

This is the *only* tool of its kind—the ONE tool that combines BOTH *Jarring* and *Releasing* action—each under the full control of the operator—for protecting modern drill strings, whether deep or shallow. And not only does it combine in *one* tool the protection usually requiring several tools, but it also provides unique operating advantages *found in no other single tool or combination of tools!*



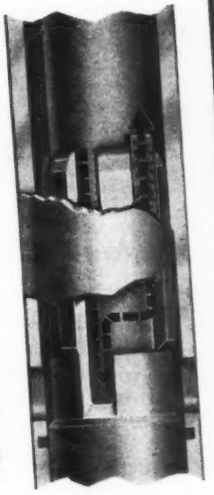
Briefly, here's how it operates . . .

TO USE AS A BUMPER SUB

you need only slack the weight of approximately 2,000 feet of drill string upon the Bumper Safety Joint. This weight actuates a positive tripping mechanism which trips *automatically*, allowing the tool to strike a sharp downward blow. Raising the pipe then *automatically* resets the tool for another blow. Blows can be struck repeatedly and continuously by simply raising and lowering the drill string.

TO USE AS A SAFETY JOINT

for quick release from stuck drill collars in the event they cannot be loosened, you simply slack the tripping weight of the string on the Bumper Safety Joint and apply left torque as the string is slowly raised. The slight reverse torque rotates the drive keys into an unlocking slot similar to a "J" tool, so that, by simply continuing to raise the string, complete release from the lower portion of the drill string is effected. Further, the mandrel remaining in the hole is smaller in diameter than the drill collars, thus greatly facilitating fishing operations in tight holes!



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On job after job—from the shallowest wells right down to world's record depth—the Shaffer-Waggener Bumper Safety Joint is bringing new safety, new efficiency to modern drilling operations. Here are a few typical accomplishments . . .

- The Shaffer-Waggener Bumper Safety Joint has been used successfully in extreme directionally-drilled wells where a slant of 60° was maintained.
- The Shaffer-Waggener Bumper Safety Joint has been released and reconnected from a 30° angle at a depth of 8,500 ft.
- At 16,883 feet in the world's deepest well the Shaffer-Waggener Bumper Safety Joint proved invaluable in simplifying a recovery operation. A Bumper Safety Joint was being used between the drill collars and drill pipe when the string parted going into the hole, dropping over 2,400 feet of pipe and drill collars 5,000 feet to the bottom of the well at 16,883 feet. The top of the fish was gripped with a socket and the Bumper Safety Joint released, immediately recovering 2,100 feet of drill pipe. The upper part of the Bumper Safety Joint was then run back into the hole below a set of jars, reconnected to the lower half of the Bumper Safety Joint and—after jarring—the drill collars were completely recovered, leaving the hole clean.

Note: For maximum protection many operators are using the Bumper Safety Joint above wash-over strings to facilitate recovery should the string become stuck.

Whether used as a Bumper Sub or as a Safety Joint, the Shaffer-Waggener Bumper Safety Joint provides unique advantages found in no other tool—advantages too numerous to outline here but which are described in detail in a descriptive bulletin which will gladly be sent you on request. Send today for your free copy of this informative eight page bulletin!

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and allowing exhaust of the drilling fluid. It is in this position that the parts are shown in Fig. 6. As soon as exhaust begins, the control sleeve returns to its uppermost position against the ram spring; and the hammer rebounds off of the anvil, which rebound, plus the force of the hammer return spring, accelerates the hammer upward to again seat the valve. When the valve seats in the lower end of the control sleeve, overtravel is provided for in that the ram spring will be compressed. This compression of the ram spring serves not only to provide for overtravel but also to store energy that is recovered in the form of increased hammer velocity on the next stroke.

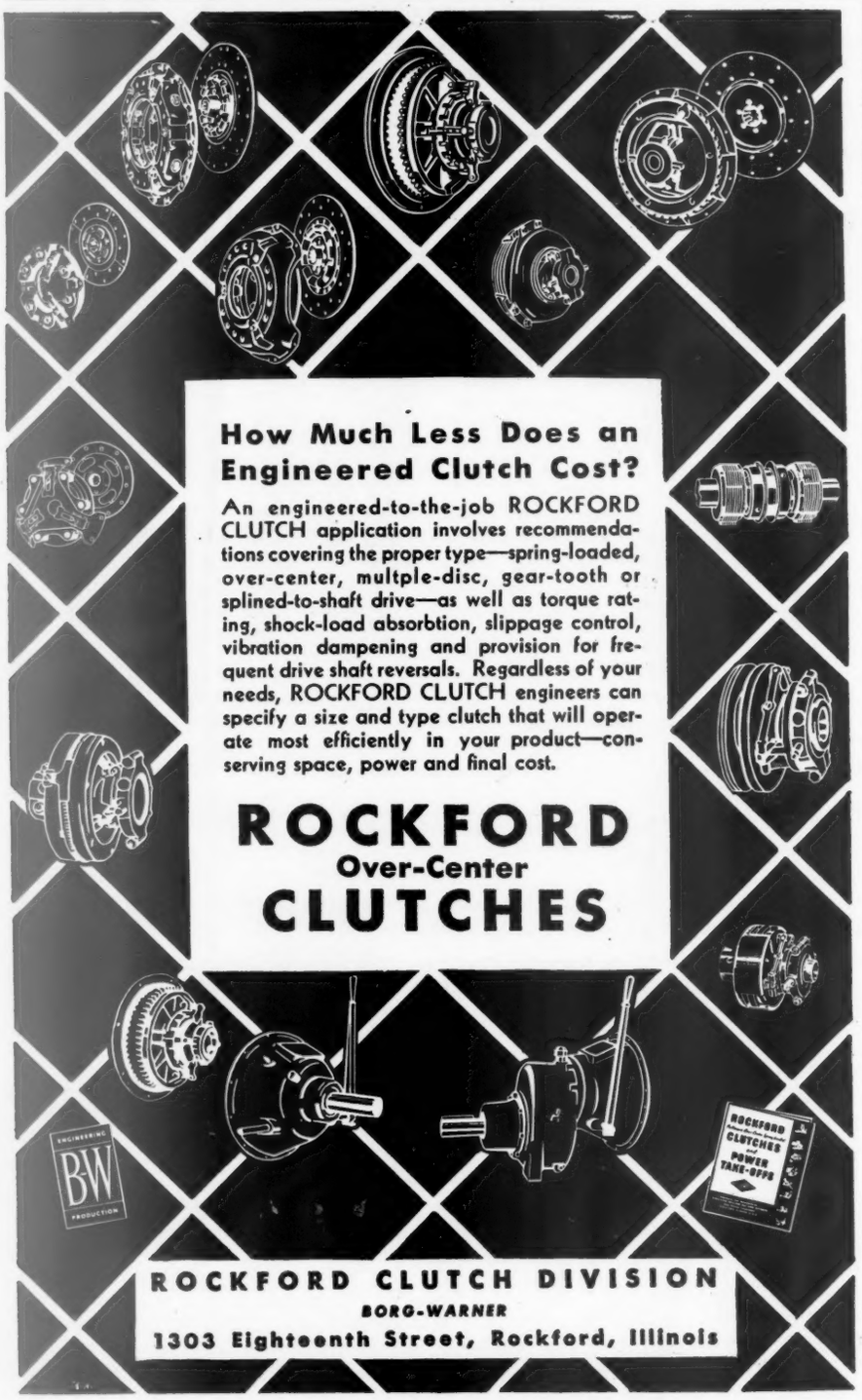
This new design includes a central opening through the hammer and spring mandrel, thus allowing fluid passage through these parts as well as around them to reduce resistance to travel of the hammer through the fluid. This change and the addition of a ram spring and the seating of the upper end of the spring mandrel on the lower end of the control sleeve account for the increased cycling rate mentioned above.

A series of tests recently completed by Shell in Canada, and not included in the earlier API paper, are summarized here. These tests include 1078 hr of operation of the Bassinger drill over a total of 3527 ft interspersed by 551 hr of conventional drilling over a total of 1003 ft. Using the conventional rate as a base, the Bassinger advantage in penetration rate varied from 300 per cent in granite to 120 per cent in sand. Using the average total conventional footage per bit as a base, the Bassinger advantage varied from 560 per cent in granite to 147 per cent in sand. This further substantiates all earlier tests and bears out that the principle advantage of the rotary percussion method is realized in the very hard friable formations.

Tests completed in July 1950 on The Carter Oil Company, Johnson-Watson No. 12 in the Elk Basin field of Wyoming show the advantage gained by the Bassinger drill over conventional under extreme crooked hole conditions where very little weight can be run on the bit. Nine Bassinger runs were made in the interval between 1378 and 2669 ft, interspersed with 6 conventional runs. The average conventional penetration rate was 4.27 ft per hour with an average of 59 ft per bit. The average Bassinger penetration rate was 8.67 ft per hour with an average of 103 ft per bit. This interval included shales, sandy shale, and sand and showed a Bassinger advantage, using the conventional runs as a base, of 202 per cent in rate of penetration and 174 per cent in footage per bit.

There were many mechanical failures in the early tools that, in some cases, increased operational costs sufficiently to outweigh the added performance and throw the economic balance in favor of conventional. Abrasion and errosion, where the sand contents of the drilling muds were high, have, of course, presented a difficult problem; however, with design and material change dictated by field experience, the latest type drills are now durable and practical pieces of drilling equipment. It is not intended to state that all breakage and wear have been eliminated but rather that they have been cut down to a point where the percussion advantage does not need to be as large as formerly to make the use of the drill economically feasible.

Operation wise, probably the three most troublesome aspects to date have been rig vibration, caving shale, and tapered hole. With respect to rig vibration, this is especially noticeable when drilling at shallow depths and has caused failure of standpipes and mud lines. These elements, therefore should be heavy and well fabricated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when contemplating the use of the drill above 6000 ft. At this depth, the shock carried through the pipe and mud column becomes negligible on the surface and disappears entirely somewhere in the neighborhood of 9000 ft. Several recent tests have shown that a splined bumper sub, run just above the drill collars, to establish a neutral point in the drilling string will eliminate practically all rig vibration at any depth. Some preliminary work has also been done on an accumulator to go in the drill string in an attempt to combat the rig vibration problem as well as caving shale mentioned below.

On several occasions while running the drill in West Texas, trouble has been encountered with caving of the Woodford Shale due to the shock caused by the drill. Although a tool has never been lost, they have been stuck for periods of several hours, therefore, when the drill is run under the Woodford, or similar shales, precautions should be taken to condition the mud to a viscosity of 100 or more before going to bottom with a percussion drill. It has been suggested that whenever the drill is to be run below the Woodford, then this shale should also be drilled by percussion so that even though the shale does sluff off, it will do so progressively and in quantities which can be handled easily. This has not yet been proved, however, it seems to be a practical approach to the problem. Considerable discussion has taken place and some preliminary engineering done on an accumulator to be placed in the string and preferably incorporated as the top section of the drill, the objective being to isolate the shock within the drill proper and prevent disturbance of the wall of the hole above the accumulator.

In the heavy chert section below 11,000 ft in the Pegasus field of West Texas, difficulty was experienced with tapered hole, and, although it was never definitely determined whether this loss of gage was begun conventionally or by percussion, it became serious enough to cause the tool to be laid down and the hole reamed to gage with diamonds. It has since been learned that the legs of the bits being used were actually pinching in, and this, coupled with natural wear on the gage of the bits, accentuated the tapering condition. The legs or bearing supports have been strengthened to take more radial thrust, which should help to maintain gage.

Conclusion

At this time, it may be concluded that the rotary percussion method offers definite advantages under certain conditions, that the mud engine or drill proper, without reference to bits, may be depended on to operate satisfactorily, and that as field experience becomes more widespread, the range of formations and conditions that can be handled to advantage by percussion drilling will increase.

Acknowledgment

The list of individuals and companies who have contributed to this development is becoming rather lengthy, and grateful acknowledgment is made to all of them. Special thanks are expressed to Ross Bassinger, Jim Hewgley, Sr., and Tom Slick. Gratitude is extended to the following companies for their part in the development program.

Shell Oil Company, Institute of Inventive Research, Bassinger Tool Company, Magnolia Petroleum Company, Atlantic Refining Company, Humble Oil and Refining Company, Stanolind Oil and Gas Company, Carter Oil Company, Sun Oil Company, Slick-Urschel Oil Company, Mountain States Drilling Company, Hughes Tool Company, Reed Roller Bit Company, Chicago Pneumatic Tool Company, Ingersoll-Rand Company, Eaton Manufacturing Company, Suhm Coil Spring Works, and Hunter Machine Company.

* * *

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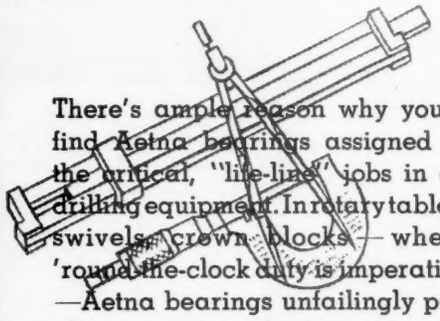

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CHECK THESE IMPORTANT FEATURES:

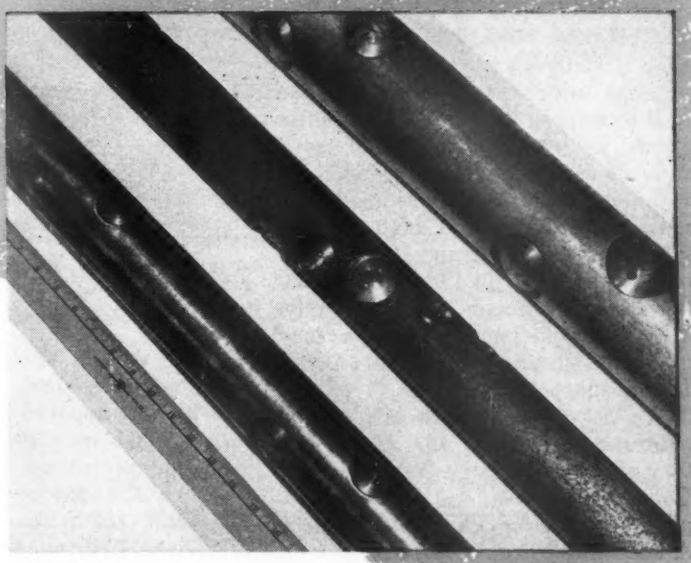
1. CARRIERS ARE DESIGNED FOR USE IN CASINGS HAVING AN INSIDE DIAMETER OF 3" OR MORE.

2. MAXIMUM NUMBER OF SHOTS PER RUN: As many as 100 shots can be fired on one trip in the hole when long sections are to be perforated.

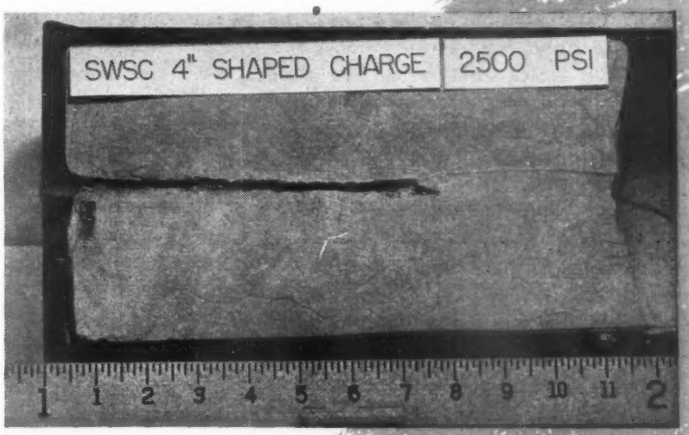
3. MAXIMUM PENETRATION ASSURED as shown in the cutaway test block.

4. WELL TEMPERATURE IS NO PROBLEM: Schlumberger Shaped Charges have been thoroughly tested at temperatures to 400 degrees F. The charges absolutely will not preignite and they maintain normal characteristics at high temperatures.

Since the Schlumberger Shaped Charge Gun was introduced eight months ago, it has established an outstanding record for economy, dependability, performance and safety. It leaves no junk of any kind in the hole and you can see if the charge has fired. It is the only shaped charge gun which brings all these advantages to the field. Ask your Schlumberger Engineer for details regarding Shaped Charge service.



2⅝" carrier, left, 4 shots to the foot; 2⅝" carrier, center, 6 shots to the foot; and 4" carrier, right, 4 shots to the foot.



Fire power is graphically illustrated by this cutaway test block.

SCHLUMBERGER WELL SURVEYING CORPORATION

HOUSTON, TEXAS

Oil Country Tubular Goods†

HENRY J. WALLACE*

On June 25 the Communists invaded South Korea. Within hours the United Nations Security Council acted. Within hours the United States armed forces were in battle. The effect of these military operations on our domestic economy differs from the effect of the outbreak of World War II. This time, demand for and production of materials such as oil and steel were at record levels before the impact of war. In the case of oil country goods, we were filling our customers' requirements through a cooperative, voluntary allocation system during most of the first half of this year. You gentlemen are faced with the problem of producing oil in increasing quantities, and producing it continuously. You are understandably concerned about the supply of oil country goods for that purpose.

We as manufacturers are equally concerned. Through the entire history of the oil industry, National Tube Company has been one of the principal manufacturers of these products. A substantial proportion of our total production is oil country goods. Through our field engineering, our sales department, our product development, and our market and commercial research, we have set ourselves to meet not only your requirements for new and better materials, but also your requirements for more products. We constantly attempt to evaluate your future needs. We live with your problems. They are as much our own as yours.

During the first half of this year, approximately 20,300 new wells were completed. It is hoped that a total of 43,000 new wells will be completed in 1950. Steel tubular goods are the largest single item of equipment required. If all sources of supply continue to be used, it now appears that the supply of oil country goods will be sufficient for 43,000 new wells.

By far the most important source of supply is represented by new production by regular manufacturers of the product. This situation today, as compared with that of the last two years, is as follows:

Estimated Oil Country Goods Production for Domestic Use and Domestic Wells Drilled (1948 and 1949)

Year	Total oil country goods production	Estimated oil country goods production for domestic use	Number of domestic wells drilled
1948	1,607,131	1,445,000	39,600
1949	1,413,834	1,272,000	38,800
Average	1,510,483	1,358,500	39,200
First half 1950	818,208 (shipped)	755,000	20,300

The reason for the lesser production of oil country tubular goods in 1949 as compared to 1948 was the steel strike in 1949. The rate of production per month in the latter year was equal to the former.

Total production of oil country goods in 1950 should reach 1,700,000 tons. Exports this year are at the rate of 7.7 per cent as compared with 10 per cent during 1948-1949. There should be available for domestic use 1,569,000 tons. The figures on production, shipments, and exports are from the American Iron and Steel Institute. Those on wells drilled are assembled from your industry publications.

Other sources for oil country goods are: (1) Conversion arrangements; (2) substitution of line pipe and pressure tubing; (3) used and reclaimed casing and tubing, and (4) imports. The first three sources are now being employed to the same extent as during 1948. For the first time since World War II, oil country goods will be imported this year, although in relatively small quantity.

Note that although 173,000 tons less of new oil country goods were available for domestic use in 1949 than in 1948, only 800 fewer wells were drilled. The apparent reason is that inventories built up in 1948 were used in 1949. If inventories are increased this year, it will not be possible to meet your goals.

On July 21 Russell B. Brown, your general counsel, wrote to President Truman. In this letter he stated, "Continuation of current drilling levels at an annual rate of . . . 40,000 wells, and the repair and maintenance of producing facilities . . . require steel mill products as follows: Oil country tubular goods, 1,568,000 tons annually." That amount from all sources will be exceeded this year.

In 1951, the amount of oil country goods manufactured will depend on the amount of steel available for the product. Military demand for steel will now be added to record civilian demand. The steel industry will operate under an allocation and priority program. The form is prescribed in the Defense Act of 1950. First, allocation will be to direct military needs; second, to civilian needs essential to the war effort. The Act provides that with respect to the balance remaining, each business shall receive "a fair share of the available civilian supply, based . . . on the share received by such business under normal conditions during a representative period preceding June 24, 1950, and having due regard to the needs of new businesses."

The oil producing industry, in relation to other industries and other phases of the oil and gas industry, will receive no less than its historical share of the steel remaining after mil-

†Presented before Independent Petroleum Association of America, St. Louis, Missouri, October 2, 1950.

*Vice president in charge of sales, National Tube Company, U. S. Steel Corporation Subsidiary, Pittsburgh, Pennsylvania.

When the Chips are Down

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Reversing dollars out of the hole? Yes—very seriously, there is a great saving to be had on many wells by using *reverse circulation.* The Guiberson "J" Head not only gives the ultimate in reverse circulation performance, but is a packed off rotary table with both kelly drive and tubing slip mechanism integral. This is incorporated in one short assembly. The fact that circulation can be in either direction at will is particularly advantageous when the operator is alternately drilling and washing a production zone. Kelly pack-off rubber turns with kelly for an effective pack-off with longer life.

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With revolutionary full floating wash pipe assembly—an exclusive Guiberson feature that doubles wash pipe packing life. Assembly rotates freely and without leakage —easily and quickly replaceable.

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itary and essential civilian demands are satisfied. The oil producing industry may well be considered as an essential civilian activity and be treated accordingly. It has been estimated that direct military and essential civilian requirements under the present program will take approximately 12 per cent of total steel capacity. If this be so, then oil country goods should be available in 1951 in quantities substantially equivalent to recent levels.

Since the end of World War II, steel production has been interrupted periodically by strikes and labor difficulties. Had there been no strikes, about 10 per cent more oil country goods could have been provided from 1946 through 1949. If it had been available, it is questionable that there would have been at any time a shortage of oil country goods in that period. Since the end of World War II, an estimated 29,000,000 tons of steel production have been lost because of these labor difficulties.

Our steel capacity has been constantly and rapidly increasing. It has increased much more than production indicates. Capacity and production per year of ingots and steel for castings, 1939-1950, is as follows:

Year	Capacity (tons)	Production (tons)
Jan. 1, 1939...	81,828,958	52,798,71[illegible]
1940...	81,619,496	66,982,68[illegible]
1941...	84,152,292	82,839,2[illegible]
1942...	88,56[illegible],970	86,031,0[illegible]
1943...	90,292,660	88,836,5[illegible]
1944...	93,652,290	89,641,6[illegible]
1945...	95,505,280	79,701,6[illegible]
1946...	91,890,560	66,602,7[illegible]
1947...	91,241,250	84,894,0[illegible]
1948...	94,233,460	88,640,4[illegible]
1949...	96,120,930	77,978,1[illegible]
1950...	99,392,800	47,106,7[illegible]*
July 1, 1950...	100,563,500	.....

*1st 6 mos. preliminary

That 100,000,000 tons of capacity is more than one-half of present world output. It is adequate to insure dominance in its field in total war. It is not sufficient to supply the demands of all steel users when those demands suddenly pile up for immediate delivery.

There is adequate rolling and finishing capacity to meet any reasonable requirement for oil country goods. There has never been a shortage of oil country goods, except when excessive demand for other tubular products coincided with excessive demand for oil country goods. There has never been a shortage of all tubular products, except when excessive demand for other tubular products coincided with excessive demand for every other type of hot rolled steel product.

If war demand for steel is much larger than presently programmed, there may be full mandatory government allocation of oil country goods and all other steel products. Such a situation existed eight years ago. In 1942, under mandatory controls, oil country goods production was cut to 458,000 tons, and in 1943 to 675,000 tons. This compares with 1936-1940 average production of 1,130,000 tons. Number of new wells dropped from a 1936-1940 average of 29,500 to 20,100 in 1942, and to 19,900 in 1943.

If military demand remains as now estimated, that is, approximately 12 per cent of total steel capacity, then we believe that allocation of oil country goods should continue on a cooperative, voluntary basis. Your Association, I understand, is on record to the same effect.

Oil country goods are used entirely by one industry for one purpose. Steel plates may be used for ships, or pipe lines, or freight cars. Steel sheets may be used for automobiles, or grain bins, or refrigerators, or mechanical toys. But we have in oil country goods an individual steel mill hot rolled product, all of which is devoted to the same use by the same industry. Yet requirements of individual users fluctuate rapidly. Requirements for individual sizes, types, and grades vary widely from month to month.

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In the American Tradition

PRESERVE YOUR FREEDOM!

Two men were crossing the ocean together. One rushed up to the other and wildly cried, "Jack, Jack, we've sprung a leak! The boat is sinking!" Jack answered, "Whadda I care! I don't own the boat."

There are too many "Jacks" in America who, by passive neglect, would let business sink. Business is our boat. We are all in it together. Anything that sinks it will destroy our way of life. Enough sunken businesses will mean government control . . . and drowning for all of us in the ocean of Socialism.

We who love freedom have a big job. Part of that job is to broadcast the truth about business and profits. For it was *successful* business enterprises that gave our country its high standard of living — enterprises that made a profit on which to thrive and grow. Growing, they gave more jobs to more workers . . . lowered costs . . . raised wages . . . paid more taxes to provide better schools, roads and bridges . . . reinvested in more efficient equipment with which to grow even larger and repeat the cycle of improvement.

When profit ceases, jobs come to an end. Business grinds to a halt. America is weakened.

Let's show all the "Jacks" why they should plug such potential leaks!

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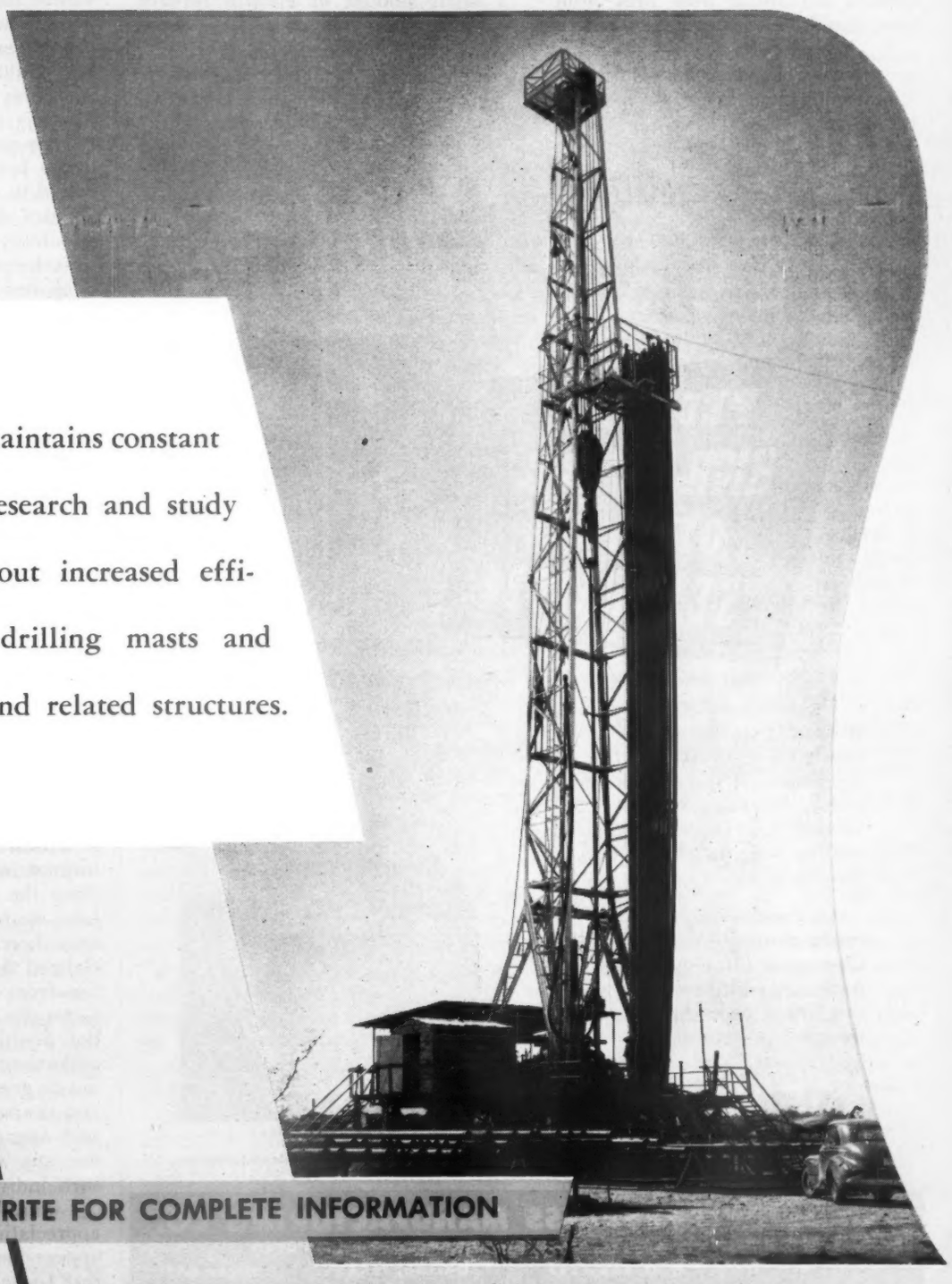

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industry know each other and each other's problems. Expressed in terms of thousands of tons and thousands of wells, a balance may be demonstrated. Yet the problems incident to supplying the right size, type, and grade, at the right time, at the right place, are complicated. The entire selling and distribution system of the oil country supply business is devoted to solving that problem economically year in and year out.

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In conclusion, I want to comment briefly on the subjects of conversion arrangements and grey market operations, because the two should not be confused.

Conversion arrangements result from the fact that there is available a small amount of electric furnace carbon steel, and there is a small amount of extra rolling capacity on pipe mills and tube mills. Regular producers of oil country goods manufacture from open hearth steel on high capacity pipe mills. They will not buy higher cost electric furnace steel and process on higher cost tube mills, because they will not sell above their published selling prices. It is possible to a limited extent for an oil country goods user to buy small quantities of this electric furnace steel and to contract directly with certain reputable manufacturers to convert this steel into tubular form. The costs resulting will be higher than prevailing market prices. Such high costs and prices in themselves do not constitute grey market operations.

A grey market operation is one whereby products purchased from a regular producer at prevailing market prices for a specific purpose are diverted to other use at inflated prices. We are deeply concerned about the possibility of our products being used in such operations. I quote a statement published by Mr. John E. Goble, President of National Tube Company, on September 18:

> "Stories have reached us that certain individuals, purporting to be representatives of National Tube Company, have stated the willingness of this company to sell pipe at a premium to certain customers, or otherwise to engage in grey market transactions in these days of heavy pipe demand. We want to deny categorically that these individuals have any authority to speak for this company. The policy of National Tube Company continues to be one of selling pipe only directly to bona fide customers at regular published prices. National Tube Company will decline to make further sales to any purchaser who is found to have resold in the grey market pipe bought from this company."

Within recent weeks, we are informed, individuals not regularly handling the sale of oil company goods have approached some of you gentlemen here. These individuals have claimed the ability to obtain production from our mills. They have offered to supply this production at substantial premiums. Not one of them is authorized to act for us. You will assist us greatly and help your industry and yourselves by reporting to us any such approach. You should refuse under any circumstances to deal with such individuals.

I want to express to you my sincere appreciation for the opportunity to appear here. I informed Mr. Warren that I would attempt to answer, to the best of my ability, any questions pertinent to this subject. * * *

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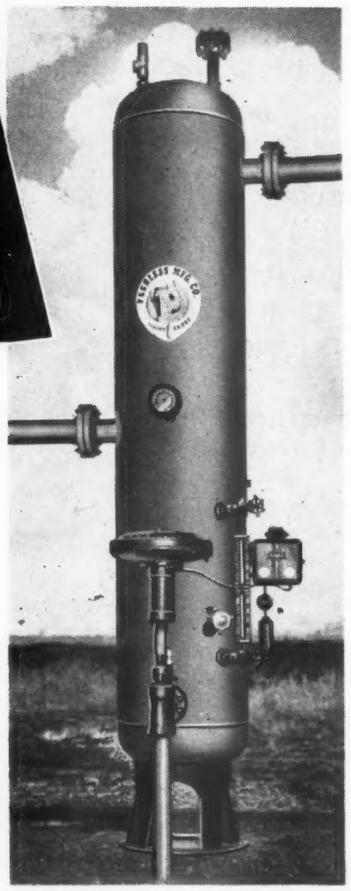

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Lubricated Plug Valves for Drilling and Wellhead Services†

E. E. HEDENE*

In the field of oil production, the engineer charged with the responsibility of designing valves for drilling and well head uses, must bear in mind not only fundamental valve principles, but also the specialized requirements imposed by the unusual physical conditions encountered in these operations. In both drilling and production, great emphasis is placed on such factors as positive operation under adverse conditions, durability and resistance to shock, corrosion and erosion. Therefore, such valves, in common with other items of oil field equipment, tend to be built on the heavy side rather than to minimum standards of size, weight, and cost.

A great variety of valve mechanisms has been used for one purpose or another and several different types have been applied to oil field services. The author's experience has been primarily with the tapered lubricated plug type; therefore, the scope of this paper is limited to a discussion of this particular style of valve.

The lubricated plug valve has come into general use, beginning about 25 years ago. This type of valve is now being manufactured by some 12 or 15 companies in the United States and in several foreign countries. Certain of these companies have patent or other working relationships, however, a number of them operate entirely independently.

The entire lubricated plug valve business has grown out of the inventions and early developments of Sven J. Nordstrom. In view of the widespread application of principles first recognized and applied by him, Nordstrom is entitled to the tribute of being recognized as a mechanical engineer who has made a substantial contribution to those fields of human endeavor wherein valves are of importance.

This paper will first enumerate the major considerations to be met in designing oil field drilling and production valves, followed by a description of the principal features of typical lubricated plug valves designed to meet these requirements, together with some discussion setting forth the reasons governing the adoption of the design elements used.

Major Requirements For Oil Field Valves

It will not be questioned that the following are primary requisites:

Standard dimensions. Standardization of dimensions affecting installation have been of immeasurable benefit to users, distributors, and manufacturers. In oil field work, the present high degree of standardization has been accomplished through the combined and harmonious efforts of several groups, notably the API, ASA, ASME, and MSS. It is obvious that the designer of oil field valves must meet the dimensional standards that are in common use.

Materials. The minimum properties of valve body materials for oil field uses have become rather well established, partly through the medium of API standards and partly by accepted practice. There appears to be practically complete agreement between users, manufacturers, and the interested technical societies as to the classes of valve body materials physically and economically preferable for most usual oil field services. There are some exceptions, notably in connection with well head valves handling highly corrosive products where the choice of optimum material requires an investigation of the specified field conditions. This situation will be referred to later.

With respect to structural details of the valve (other than major dimensions of the body), the designer is entirely "on his own". Having established the design of the valve as a whole, he must analyze each component part carefully and select materials that will meet both manufacturing and performance requirements.

General design. It is obviously desirable that the valve be as simple, rugged and compact as possible. The designer must make every effort to minimize the total number of parts and to avoid the use of complex or delicate members, and "tricky" assemblies and adjustments.

Reliable operation. The valve must be designed and constructed to stand up in the face of adverse field conditions such as long periods of standing in one position, neglect of maintenance, shock, corrosion, high-velocity abrasion, and generally rough handling both before and after installation.

Working and test pressures. While oil field valves correspond dimensionally with the flange standards of the several ASA service classes, there are some differences between ASA and oil field pressure ratings. In general, it may be said that oil field ratings equal, or exceed, ASA ratings. It is customary to identify oil field valves by their oil field pressure ratings, the test pressures, or both. Working pressure ratings used in oil fields are 720, 960, 1500, 2000, 3000, 5000, and 10,000 psig. Minimum test pressures are double these working pressures except that the 720-lb, 960-lb, and 10,000-lb valves are tested at one end one-half their working pressure ratings.

In designing a valve for a given service pressure class, the designer must provide not only for the test pressure, but also make ample allowance for shock, piping stresses, etc. In general, these allowances are much greater than those required for general service because of the greater probability of shock. For example, drilling mud is circulated at high pressure and high velocity, using reciprocating pumps that produce momentary shock pressures that may exceed by several times the normal or "static" pressure shown by a gage. Likewise, valves on producing wells are frequently exposed to shock when "slugs" of liquid are picked up by the high velocity stream of gas passing through the tubing leading to the well head.

To one not familiar with the char-

†Presented by E. E. Matheson at the annual meeting of the Petroleum Division of ASME in New Orleans, Louisiana, on September 27, 1950.

*Chief Engineer, Nordstrom Valve Division Rockwell Manufacturing Company, Pittsburgh, Pennsylvania.

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acteristics of high pressure flowing wells, this situation may be visualized by comparing it to the action of an ordinary coffee percolator, except that it is necessary to imagine that the tube of the percolator is, say, two miles long, and that the flowing pressure is several thousand pounds per square inch.

Positive shutoff. The primary purpose of any valve installed in oil field piping is to shut off positively when called upon to do so. This is particularly true of the so-called "master valve" on a well head, since this valve is the final recourse when it is necessary to shut in the well for any operating reason or to permit the replacement of well head components above the master valve. Not only is valve leakage undesirable and perhaps hazardous in itself, but because of the high pressures involved, a small internal leak is almost certain to cause a cutting or wire drawing action with the result that such a leak tends to become enlarged. With some of the well pressures now being handled, a very small initial leak can rather quickly result in a valve being cut out to a point where it is entirely inoperative.

Long life. Well head equipment is selected with the expectation, or at least the hope, that it will retain its effectiveness indefinitely. The reasons for this hardly need elaboration. Likewise, in deep drilling operations, a valve failure on mud circulating lines at best will interrupt the use of equipment and personnel with heavy standby charges, and, at the worst, may be the cause of very serious conditions such as lost circulation or a blowout.

From the foregoing, it will be readily apparent that the valve designer has a very considerable responsibility if he is to produce working designs for valves that will perform properly and endure for a prolonged period of time under these operating conditions.

Characteristics of Lubricated Plug Valves

In addition to the general requirements set forth, the design of lubricated plug valves imposes certain others because of their mechanical characteristics, including the following:

Rigidity. A prerequisite for this type of valve is the establishment and maintenance of an accurately tapered fit between the body and plug members. For this reason the valve body and plug must be carefully analyzed to assure that the deflections that occur under working conditions will be held to a very small limit. In actual practice, it works out that deflection, rather than allowable stress, is the determining factor in establishing the dimensions of these parts. Another way to say it is that bodies and plugs designed to keep deflections within necessary limits result in working-stress loads much lower than those ordinarily permissible even under maximum pressure conditions.

In laying out body and plug proportions and sections, it is not practical to predict the stresses and deflections exactly because the forms involved do not readily lend themselves to analysis. These stresses and deflections can be approximated within reasonable limits by empirical methods and by knowledge of past measurement. However, it has been the practice of the author to subject prototypes of each new valve design to actual pressure conditions in the laboratory and to determine the stresses and deflections accurately by measurement. In the earlier years, these measurements were taken by the use of dial type indicators, however, the electrical resistance strain gage method was adopted soon after it became available and has been used thereafter.

Provisions for lubrication. In order for the tapered rotary plug type valve to function properly, it is necessary to design into the valve a lubricant system that will most effectively carry out the several useful functions of pressure lubrication. The essential elements of such a lubricant system are as follows:

1. Provision for the external application of plastic lubricant at pressures substantially higher than the maximum line pressure within the valve.

2. A check valve to prevent outward back-flow of lubricant from within the valve when the lubricant device is detached. In practice, check valve units are in multiple, to assure closure under all conditions.

3. A system of lubricant distributing grooves interrupting the area of contact between the body and plug.

4. Connection of the lubricant groove system with a fully enclosed chamber surrounding the smaller end of the tapered plug. The provision of this chamber permits the use of the lubricant itself to develop a powerful "jacking" force, or thrust, directly against the smaller end of the plug in a direction tending to unseat it momentarily when lubricant pressure of sufficient magnitude is applied.

Flexible plug seating thrust. To obtain proper functioning in a tapered rotary plug type valve, it is obviously necessary that some means must be provided to develop and maintain axial thrust upon the plug in a direction tending to move it toward the seat. In designing such a valve for high pressure service there are a number of essentials relating to the thrust mechanism, namely;

1. There must be a means of establishing the correct degree of thrust within reasonable limits of variation. If the thrust is too little, the plug will not be seated with sufficient force to permit it to shut off against line pressure. If the thrust is too great, the valve will be difficult to operate. A threaded thrust screw is a simple and effective device for developing the thrust.

2. The thrust may be transferred to the plug in a manner which will involve a minimum of frictional resistance against turning. A large single, hardened ball is a very satisfactory thrust-carrying device.

3. The thrust system must include an element of flexibility, or resilience, to permit the plug to be jacked slightly away from the seat when necessary and to accommodate varying plug positions corresponding to different thicknesses of lubricant film between the body and the plug.

4. The resilient element should be of such nature that its characteristics will not change for an indefinite period of time, to assure that once the proper plug thrust adjustment is made, it will then be permanent for the entire life of the valve and for the full range of variations in line pressure, degree of lubrication, etc.

The unseating force, developed from time to time in the lubricant chamber, and the resilient seating thrust acting in the opposite direction, provide a balance of forces that maintain the plug in proper position relative to the body seat under the various conditions that are encountered in operation. Under normal conditions, there is a film of lubricant between the body and the plug surfaces. This film serves to reduce turning friction and to prevent intrusion of corrosive or erosive material and also acts as a very effective sealing medium to prevent leakage between body and plug. From time to time, the lubricant film requires renewal, and this is done by simply injecting an additional supply into the valve through the check valve. At the time lubricant pressure is applied, the thrust generated in the jacking chamber over-balances the resilient seating thrust, whereupon the plug separates slightly from its seat. At the instant this occurs, the lubricant in the grooves, being likewise under pressure, immediately spreads out into the minute space created between the plug and body surfaces by the jacking action. At the same time, the escape of lubricant from the grooves limits the

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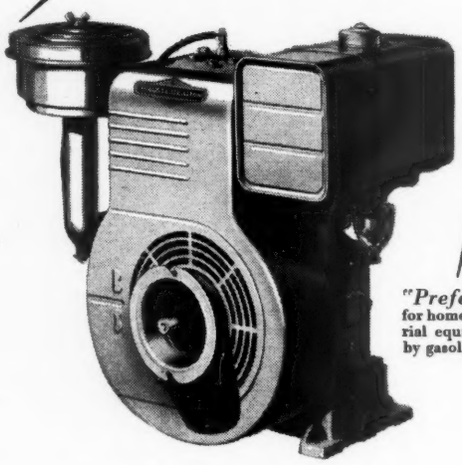

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amount of lubricant pressure that can be built up in the system and thereby limits the lifting of the plug. The correlation of these forces is such as to provide just the amount of unseating that is required to admit lubricant between the surfaces, however, no space is created that is not immediately filled with lubricant. Therefore, the intrusion of foreign material to the seat is automatically prevented. If the plug should be frozen in the body, as it may be if permitted to stand without lubrication for a long time, it is only necessary to apply sufficient pressure to the lubricant to build up a thrust on the small end of the plug sufficient to overcome the adhesion existing between the plug and body. It is quite surprising how easily this can be done with the equipment ordinarily used for valve lubrication in the field. The most common devices are a simple lubricant screw in the valve itself, or a booster type grease gun.

The layout of the lubricant groove system requires some attention. It is desirable to have grooves located above, below, and at each side of the port, and at both ends of the valve, so as to assure complete distribution of the lubricating and sealing film to all parts of the valve seat. This involves the use of four equally spaced longitudinal grooves in the seat, and whether these longitudinal grooves are located in the body or plug surfaces, the 90-deg rotation of the valve plug in its operating range will bring a diametrically opposed pair of lubricant grooves into contact with the line fluid passages in intermediate position of the plug. Therefore, in laying out the lubricant groove system, it is necessary to locate certain of the grooves in the body surface and certain of the grooves in the plug surface and to arrange them so that the act of turning the plug away from full open or full closed position will, at the same time, disconnect the exposed grooves from the rest of the lubricant system. At the same time, the groove layout must provide that the remaining pair of longitudinal grooves, which are never exposed to the port, remains connected to the lubricant inlet and to the lubricant chamber in all positions of the plug. With a proper distribution of grooves as described, the effect of line fluid in removing lubricant is confined to the exposed portions of two grooves only, and the normal functions of jacking and lubrication can be carried out in any position of the plug.

In any type of valve there must be a rotating or reciprocating stem to provide for operating the interior movable valve member from an exterior

position. The plug type valve requires rotary motion only which simplifies the stem problem, however, there are a number of important matters involved. One of these is that in any valve, one end of the stem is exposed to line pressure within the valve, whereas the other end is subjected to atmospheric pressure only, thereby setting up an outwardly acting force due to the difference in these pressures. In high pressure valves, this pressure thrust may amount to a very substantial figure. In addition, there is the perennial problem of scaling a movable joint. This problem is encountered not only in valves, but in other pieces of equipment.

In plug valves for moderate pressures, it has been found practical to make the stem an integral part of the plug, with the result that the plug-holding thrust means also carries the line pressure displacement force acting on the stem. In valves designed for several thousand pounds pressure per square inch, however, it has proved inadvisable to handle the stem thrust in this manner, as the forces to be carried are of such magnitude as to complicate the maintenance of proper plug seating thrust with line pressure varying from 0 to maximum. Therefore, in plug valves of this class, it has been found advisable to use separate plug and stem members, to couple them together as to rotation only and to carry the thrust of each separately. This requires adopting the so-called inverted plug design in which the stem joins the tapered plug at its smaller end. This permits the plug seating thrust member to be located centrally at the larger end of the plug, which would not be practical if the plug stem also joined the plug at this position. Attachment of the stem at the smaller end has other advantages, including the fact that the stem enters the valve body at the lubricant chamber, thereby allowing the same lubricant system to supply lubricant to the stem seal.

Several different methods have been tried for transferring the stem thrust load to the valve body. The method that has proved the most successful is the use of a long running thread between the stem and the surrounding portion of the body. This method has several advantages. By its use, it is possible to transfer the very heavy thrust load between the two parts without requiring bulky structures, as the load is carried by the thread contact along its entire length, thereby distributing the load over a considerable area of metal, extended axially instead of radially.

Of course, this construction requires the establishment and enforcement of rather close thread tolerances, particularly lead-error. The threaded construction also facilitates sealing the movable stem joint without the introduction of excessive friction. While the mating threads have a definite clearance space between them, this space is of small cross-sectional area and at the same time, greatly elongated. In a typical valve this clearance space can be considered as a helical tube several feet long and with a cross-section of only a few thousandths of an inch at its greatest dimension. Furthermore, the inner end of this clearance space is in communication with the lubricant chamber, which means that the thread clearance space is effectively sealed by the same medium used to seal the valve seat proper. As a final step, a simple packing arrangement of small dimensions, and therefore small torsional friction, is placed near the outer end of the stem. This packing is only required to keep lubricant from seeping outward through the stem clearance and the lubricant itself is the primary seal to prevent the escape of line fluid. This form of sealing may be likened to the familiar practice of "snubbing", whereby a few turns of a rope around a post allows a great force at one end of the rope to be controlled by exertion of a minor force at the other end of the rope.

A very effective design for this secondary stuffing box is to make it in the form of an annular groove interrupting the body stem threads near the outer end of the thread engagement and to fill this groove with a plastic injection type packing forced in through a check valve fitting by means of a simple screw. There is no exit for the escape of packing and it remains in place and effective indefinitely. Additional packing can be forced in through the check valve whenever required, although it has developed that this has to be done very infrequently. An important practical feature is that this type of packing can be renewed whenever necessary with the valve in any position and under full line pressure.

Valve lubricant. In discussing lubricated plug valves one cannot escape referring to the properties of the lubricants themselves. As the effectiveness of the lubricant resides in the maintenance of a film in contact with the line fluid, the lubricant must possess a reasonable degree of stability under these conditions; that is, it must not react chemically with the line fluid nor be dissolved readily by it. Practical conditions involve variations in temperature; therefore, the lubricant should have as flat a temperature-viscosity

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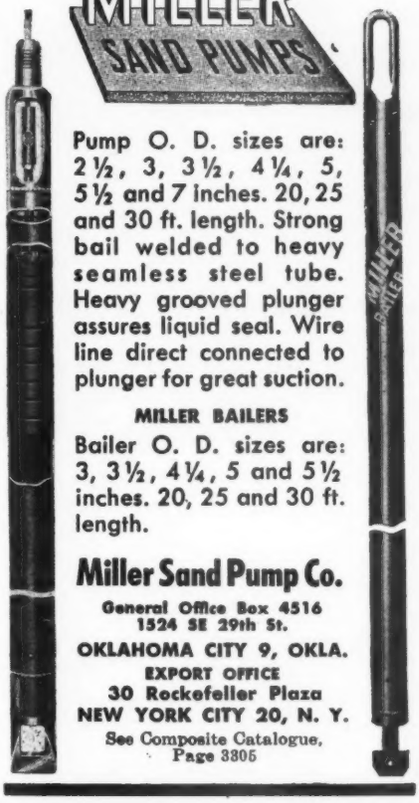

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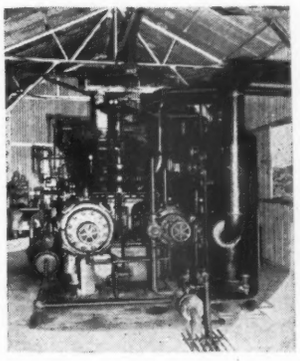

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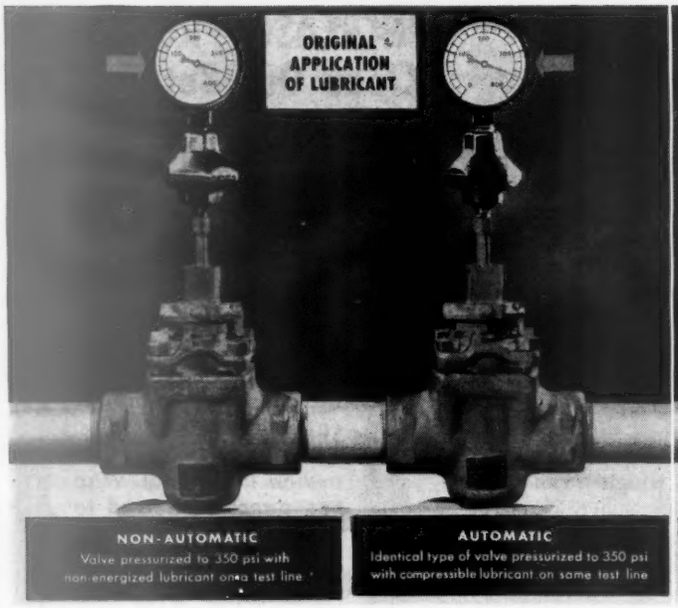

ORIGINAL APPLICATION OF LUBRICANT
NON-AUTOMATIC
Valve pressurized to 350 psi with non-energized lubricant on a test line
AUTOMATIC
Identical type of valve pressurized to 350 psi with compressible lubricant on same test line

FIG. 1

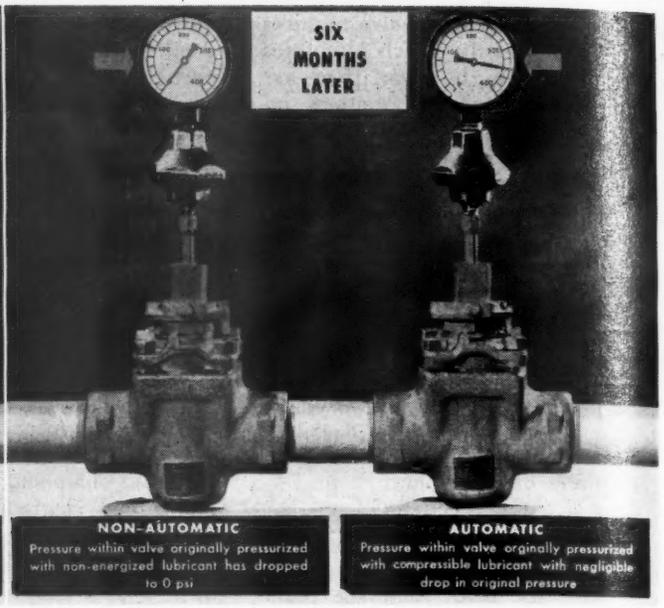

SIX MONTHS LATER
NON-AUTOMATIC
Pressure within valve originally pressurized with non-energized lubricant has dropped to 0 psi
AUTOMATIC
Pressure within valve orginally pressurized with compressible lubricant with negligible drop in original pressure

FIG. 2

curve as can be achieved. The lubricant must flow freely enough so that it will reach all parts of the working surfaces, but it must also possess sufficient viscosity and metal adhesiveness so that it will effect a lasting seal. It is very important that the lubricant have no tendency to solidify, even after a long period of time. Such an action would result in eventually plugging the lubricant grooves and passages, which would make it impossible to inject fresh lubricant into the valve. It has been found to be greatly preferable to use lubricants that tend to dissipate or dissolve away slowly, rather than to make them entirely resistant with the result that they may eventually harden.

The requirements of plug valve lubrication are so different from those of other equipment in general use as to make commonly available industrial lubricants unsuitable for use with valves. The application of the lubricated plug valve in a great variety of fields has brought along with it the development of special plug valve lubricants. Several firms are engaged in manufacturing this type of material and they are readily available for a great many different services.

Automatic lubrication. Ever since the inception of the lubricated plug valve business, valve manufacturers and users have given a great deal of thought to the possibility of automatic lubrication. Many automatic lubricating devices have been tried. Some of these were intended to be built into valves; others were exterior attachments. None of them have come into general use as they are bulky, delicate, expensive, or all three. A surprisingly simple solution to this problem has been brought forth recently in the form of a lubricant which is in itself compressible. When this lubricant is injected into a valve, not only is the entire lubricant system filled—as with conventional lubricants—but an additional supply is compressed into the same space. As the lubricant film is gradually dissipated from the working surfaces in the operation of the valve, the stored compressed lubricant gradually expands and renews the supply on the working surfaces. The degree of compressibility of this material is quite large with the result that the frequency of lubricant applications required in comparison with the use of conventional lubricants is of the order of at least 5:1, and in many cases it has proved to be 10:1, 20:1, and even greater. The increased effectiveness of compressible lubricants depends upon complete confinement; therefore, it will give results no better than non-compressible lubricants in valves which are worn, scored, or corroded to a point where the lubricant pressure cannot be developed and maintained. It is likewise not particularly effective in valves whose design does not provide a fully closed lubricant system.

The practical operation of compressible lubricant is shown in Figs. 1 and 2, which are based on actual photographs. The lubricant pressure recorded by the gages are a direct index of the energy acting to move the lubricant to the seating surfaces. It will be noted that with the valves standing idle for a period of six months, practically the full original lubricant pressure was maintained with the compressible lubricant, whereas no pressure was retained with the non-compressible lubricant. Other observations have shown that non-compressible lubricants do not retain any appreciable stored pressure for more than a few hours at the most.

Fig. 3 shows a typical lubricated plug valve and the measured amounts of the two types of lubricant that can be contained in the lubricant system of this valve. In either case, injection of amounts greater than those shown in the graduates will simply result in lifting the plug slightly from the seat and the escape of excess lubricant. Of course, the volume of lubricant in the graduate at the left is actually compressed in the valve to a volume corresponding to that shown in the right-hand graduate. The difference in the heights of the two lubricant columns represents the volume of compressible lubricant available for self-feeding action in the valve.

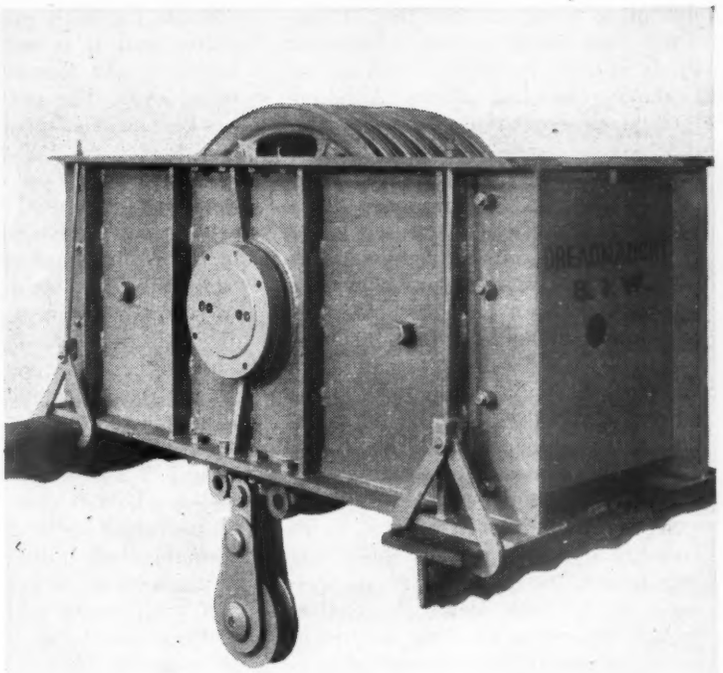
The development of compressible lubricant has certainly been a boon to the valve designer as it has relieved him of the apparently unsolvable problem of a practical, salable, automatic lubricator that has frustrated him for many years. The author can neither claim or imply credit for this development as it was entirely the achievement of a colleague, Dr. George F. Scherer.*

Corrosive oil field service. In an increasing number of cases the problem of resistance to definitely corrosive media is added to the considerations already enumerated which the valve designer must face. Here he has a problem that, in some respects, is more

*Director of Research, Nordstrom Valve Division, Rockwell Manufacturing Company.

NEW DESIGN

pays off in trouble-free operation



A little over a year ago, Beaumont Iron Works introduced its new Dreadnaught Type KN Crown Block with its companion Dreadnaught Type PN Traveling Block. The completely new ideas embodied in the design of this block combination made such excellent common sense that the Dreadnaught pair was an immediate success. Repeat orders coming in from major customers are the best endorsement of this new design.

NO OTHER CROWN BLOCK HAS ALL THESE FEATURES...

Space Saver—Centerline and narrow centers between sheaves permit block to be hoisted through water table in one piece.

Beam Support—Large diameter center pin mounted in box built into beam *on its center line.* New design provides extremely sturdy and rigid support and reduces over-all height of block.

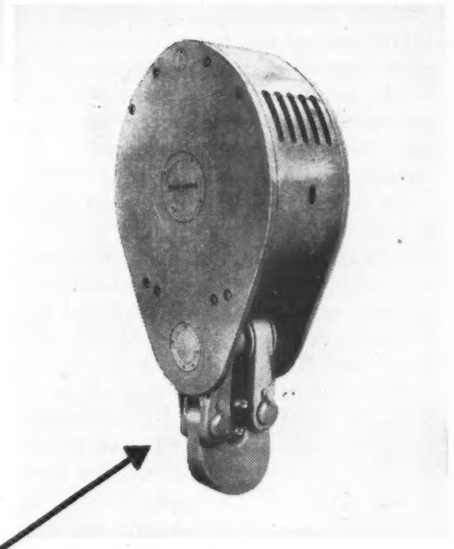
Two Mountings—As center pin is on center line of beam, *either flange* of beam can be set on water table beams.

Four Positions—By turning block around, deadline sheave can be set in any of *four different positions* to minimize Brinelling effect on races, increasing life of bearings in end sheaves.

Bearing Life—A new idea in bearing design. Row of ball bearings in bronze retainers placed between each sheave. Acts as thrust bearings, resisting both end-wise movement and twisting effect caused by line passing between crown and traveling block.

All-around Protection—Labyrinth type seals between each sheave serve as grease seals and dust guards.

Rated Capacity—360 tons at 100 rpm—600 tons at 10 rpm.



STREAMLINED SPACE-SAVER TRAVELING BLOCK

Extreme Narrow-Width—Streamlined design did the "impossible." Although sheaves and bearings are of larger diameter, and maximum load capacity is built into design, the PN Traveling Block is so narrow and compact it does not restrict pipe racking space on deepest holes.

New Thrust Design—Each sheave mounted on radial roller bearing, separated by row of spherical ball bearings. Adds to bearing life and prevents radial rollers from skewing as *they carry no thrust load on the ends.*

New Strength—Load carried through rolled steel side plates. No spacer plates employed. The becket, capable of carrying load of one line, is buried within block.

Rated Capacity—300 tons at 100 rpm—500 tons at 10 rpm.

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difficult to work out than that of handling even more violently corrosive fluids in other industries, such as, for example, chemical plants. Although the chemical plant may have highly reactive materials to handle, the pressures are usually low and the valve designer has a great deal more latitude in his choice of materials than in the case of corrosive oil field services where he must not only provide against corrosion but must also stay within the bounds of minimum physical properties required to handle oil field pressures. Furthermore, he must not only meet the physical and chemical requirements but he frequently finds he must do so within a cost limit.

The so-called corrosive distillate wells that have been brought in in increasing numbers in the Gulf Coast area present the dual problem of pressure along with definitely active, though somewhat variable, corrosion action against ordinary metals of construction used in oil well components.

Very extensive field and laboratory investigations carried out by the principal operators in the corrosive distillate fields, with the assistance and cooperation of other interested parties, have brought forth certain reasonably definite data helpful to the valve designer where these conditions are to be met. As presently advised, metals suitable for oil field valve use, and which have either been adopted or are being seriously considered for adoption for corrosive distillate well head use, include the following:

From the information that has come to hand, it appears that 12-14 per cent chromium steel is entirely resistant to the type of well head corrosion now being dealt with. The physical properties of this material are entirely suitable for high pressure well head valves and it is not too difficult to handle in the foundry or in the machine shop. The only objection that has been encountered is that it is quite expensive.

Both 5 and 9 per cent nickel alloy steels are being used to a considerable extent in corrosive wells, particularly in the form of tubing strings. It appears the 5 per cent nickel steel has corrosion resistance sufficient to handle the problem in certain fields, whereas in others, the 9 per cent alloy is required. Sufficient data has not yet been received to determine whether or not the valves made from parts comprising 5 and 9 per cent nickel steel castings will exhibit the same range of corrosion resistance as that of wrought steel tubing with the same percentages of nickel.

A preliminary cost study indicates that 5 per cent nickel steel valves can be manufactured somewhat cheaper than 12-14 per cent chromium steel valves, however, it appears that 9 per cent nickel steel valves may cost nearly as much as the 12-14 per cent chromium alloy. The 9 per cent nickel alloy is very difficult to handle in the foundry.

The tendency is, at the moment, that where there is any doubt, 12-14 per cent chromium valves are recommended.

Welded hard facings. During recent years techniques have been developed for applying welded coatings of hard-facing material to the body and plug seating surfaces. This material is usually the tungsten-cobalt-chromium type, however, the chromium boride type may also be employed successfully. Use of these materials as facings for the valve contact surfaces produces extreme resistance to erosion, corrosion, and galling.

In oil field work the following are the principal applications of hard-facing:

1. In drilling mud valves to resist the severe abrasion encountered in pumping high pressure mud fluids at high velocities.

2. In valves for handling extremely high pressures, such as the 10,000 lb WOG class of well head valves. The low frictional properties of the hard-faced surfaces prevents galling when valves are turned while carrying the thrust load set up by extremely high differential pressure.

3. For valves handling intermediate as well as high well pressures, where severe abrasion is encountered due to sand or other solids being carried by the flowing stream.

4. To resist chemical attack under conditions such as those of corrosive distillate wells. Where this problem is encountered, the hard-facings may be used in conjunction with either standard materials or alloy steel depending upon the severity of the corrosion.

The hard facings method referred to was first developed in connection with valves to handle combinations of high temperature, corrosion and abrasion in certain oil refinery processes. A great deal of work had to be done to develop techniques for successfully applying hard-facing materials over large tapered surfaces without cracking, dilution, or undue warpage of the valve parts, as well as for the machining of these extremely hard materials to the degree of accuracy required for an intimate tapered fit. This work cannot be gone into here and it will suffice to state that, as might be expected, the solution of the various problems

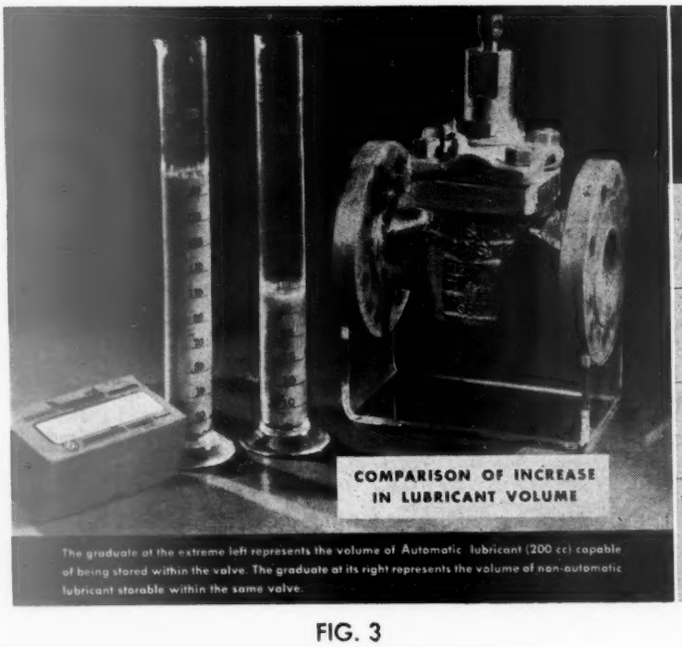
COMPARISON OF INCREASE IN LUBRICANT VOLUME
The graduate at the extreme left represents the volume of Automatic lubricant (200 cc) capable of being stored within the valve. The graduate at its right represents the volume of non-automatic lubricant storable within the same valve.

FIG. 3

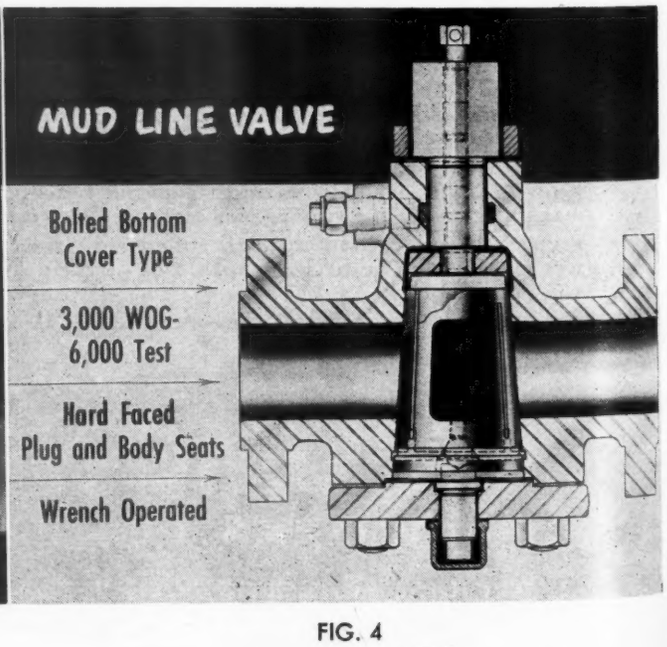

FIG. 4

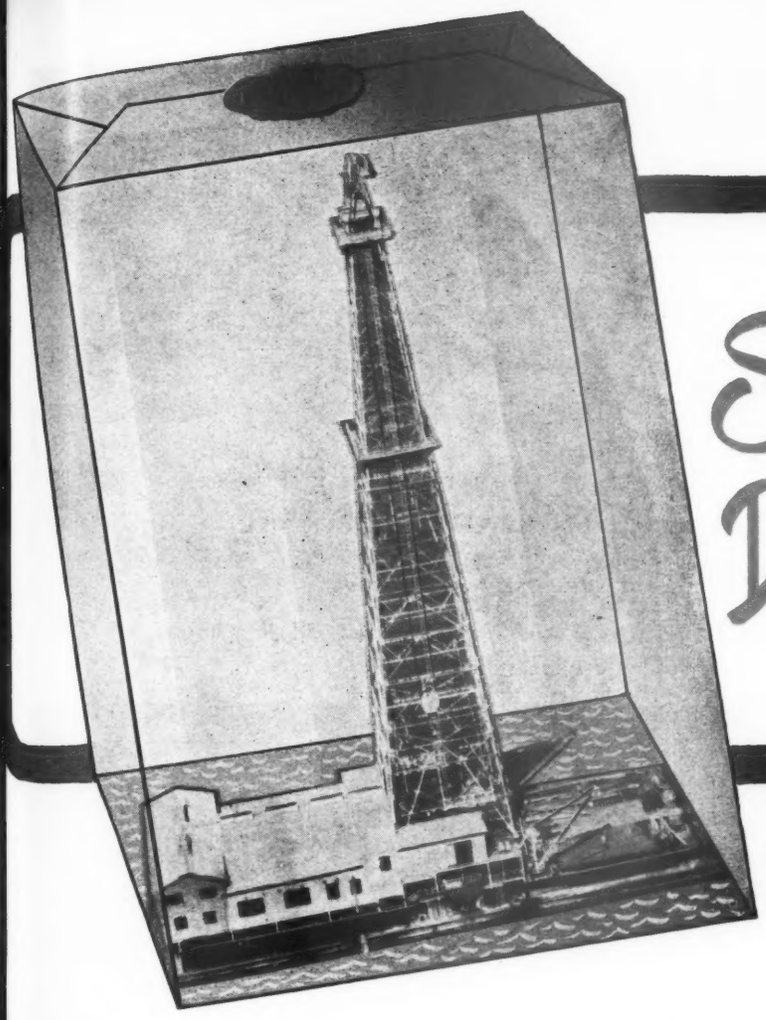

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FIG. 5

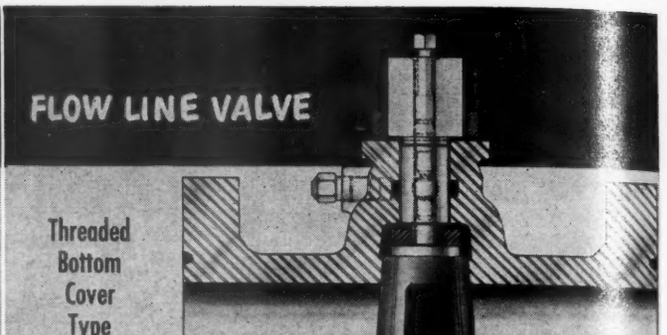

FIG. 6

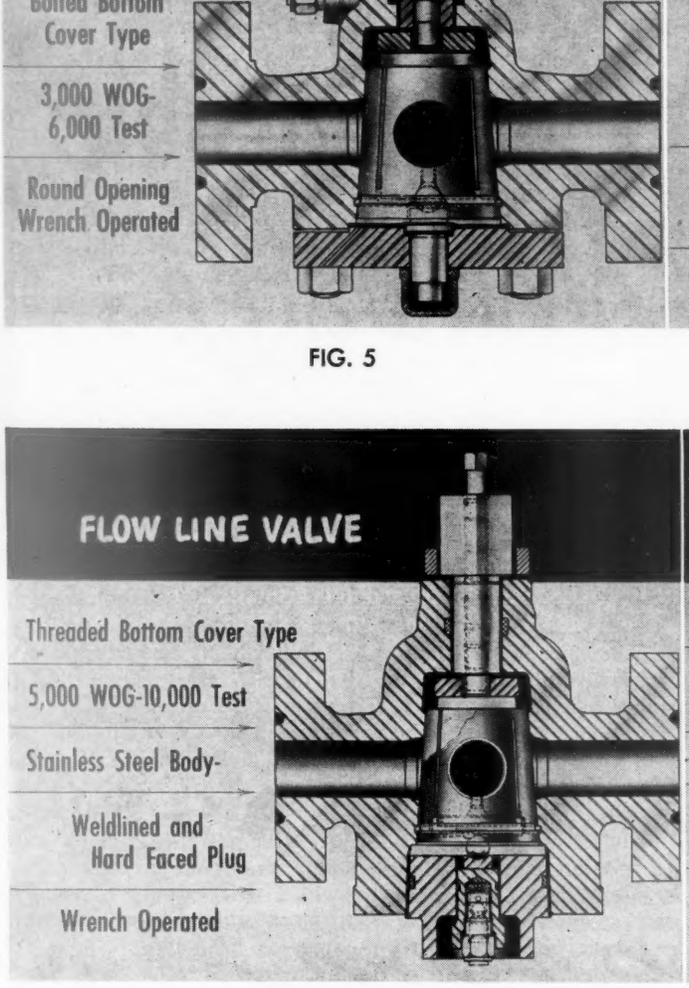

FIG. 7

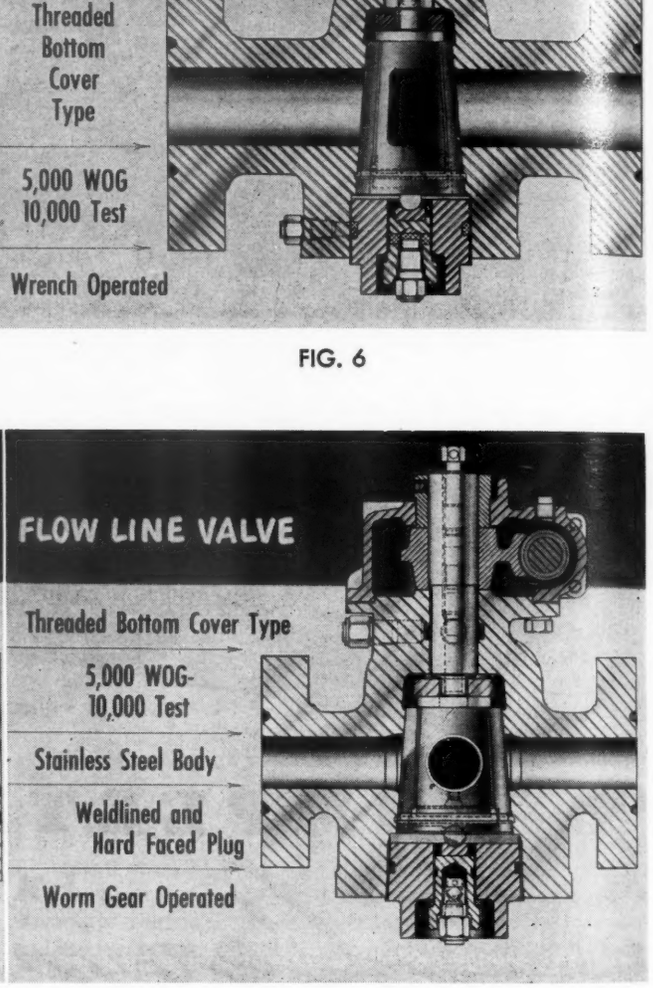

FIG. 8

was a combination of methods and especially developed equipment worked out by trial and error.

Typical oil field designs. Up to this point, this paper has dealt with the basic requirements to be met with oil field valve and with the major design features of lubricated plug valves developed to meet these requirements. Numerous incidental, though necessary, design details are also involved, however, a review of all of these details would prove much too lengthy. So that some of the complete structures may be visualized, a number of illustrations have been prepared and will be referred to briefly. The valves illustrated are all of the same design pattern and differ only as to variations which have been worked out for various specific applications.

Fig. 4 is a sectional assembly view of a current working design intended for service pressures up to 3000 lb WOG. The various design elements previously described are embodied in this valve. In this pressure range, the body closure is in the form of a bolted steel disc or flange which carries the adjusting screw and which supplies sufficient flexibility to give the necessary resilience in the plug seating thrust. The thrust is transmitted from the adjusting screw to the single thrust ball located in the center of the plug by means of two thrust buttons, one located on each side of a flexible metal diaphragm assembly, the outer edges of which are clamped between the cover flange and body. This construction allows a certain latitude of axial movement in the thrust assembly, at the same time preventing internal pressure from reaching the threaded opening through which the adjustment screw passes.

It will be noted that the stem and plug are two separate members and while not previously mentioned, these parts are joined through an equalizer ring that causes them to rotate together. This assembly is on the principle of an Oldham coupling, which eliminates radial forces between the two parts that are joined together rotationally. The equalizer ring also accommodates the slight endwise movement of the plug stem which results from its threaded engagement in the body without disturbing the position of the plug in its seat.

The valve shown in Fig. 4 has tapered port openings in the plug and body. The particular valve illustrated includes hard-faced body and plug tapered surfaces and is intended particularly for drilling mud service. This same valve without hard facing, but with hardened steel plug, is also

widely used in side-arm installations on producing well heads.

The valve shown in Fig. 5 is of the same design as the one previously mentioned except that this valve has full diameter circular port openings that modifies the valve proportions to the extent that the plug is of greater diameter for a given pipe size than the plug with tapered port shape. Roundway valves are customarily used in the master valve positions on producing wells to permit insertion of tools, instruments, etc. into the tubing bore.

Figs. 6 and 7 show a modified bottom-closure construction used in valves for service pressures of 5000 lb WOG and higher. In this design, the body opening is closed with a threaded plug, resulting in more compact construction than would be possible with a flanged, bolted closure sufficiently massive to handle this higher range of pressures. The engaging threads between the closure plug and the body are of buttress form, which permits heavy thrust loads to be carried without setting up undue hoop-stress, as would be the case with conventional V-threads.

The closure plug carries a thrust screw that acts through a thrust button and a single ball at the center of the plug. The necessary resilience is provided in the form of a heat-treated steel spring-disc, not visible in the illustration, interposed between the ball and the plug. This construction has the advantage of having the spring loading holding the plug seated as is the case where the flange bottom cover design is used. This effect is not serious for pressures of 3000 psig or less, but in the higher pressure valves of 5000 lb to 10,000 lb WOG, it is desirable to eliminate pressure-induced thrust variations.

In the threaded-closure design, the injection type packing principle is used to seal both the closure threads and the adjustment screw threads. Fig. 6 has tapered port and shows standard construction with hardened steel plug.

Fig. 7 has round-opening port and in this case, the valve is of the stainless steel type intended to handle corrosive distillate. In the valve illustrated, the body is of 12-14 per cent chromium alloy and the plug is of special coated construction. The plug is of carbon steel, with the tapered surface hard-faced with Stellite. The fluid passage through the plug has a welded lining of 18-8 stainless steel to prevent attack on the carbon steel plug material by the line fluid passing through the valve. This composite construction provides a corrosion resistant plug with hard faced surface that will not gall when turned in contact with the body seat. In a modified construction, this type of valve is also built with a heat-treated 12-14 per cent chromium plug, thereby providing a combination of surface hardness and corrosion resistance without the expensive coating. Indications to date are that this latter construction has quite satisfactory corrosion resistance.

Fig. 8 shows the same construction as Fig. 7 with the addition of enclosed worm gearing through which the valve mechanism is operated. This type of worm gearing is standard for any of the valves described herein, where the combination of size and pressure rating is such as to require torque multiplication for easy operation or to permit the valve to be opened and closed more gradually than can be done with direct wrench operation.

Conclusion

This paper has attempted to reflect the highlights of oil field valve requirements as they are presented to the valve designer and to outline the major design elements that have been developed and put together to meet these requirements in the case of the particular type of valve that has been discussed, namely, the lubricated tapered plug valve. * * *

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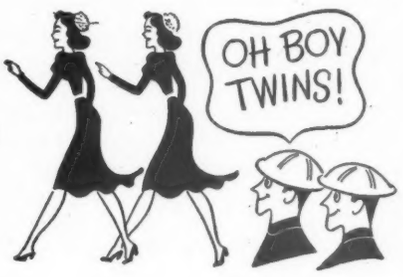

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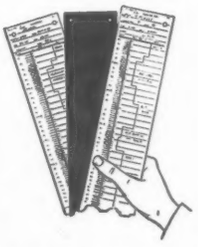

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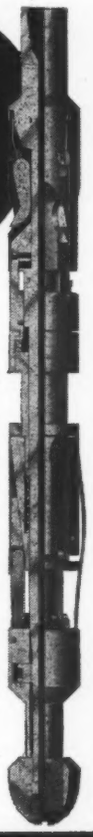

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NEWS

API Honors Seven Members Of Production Division

Seven men were awarded "Certificates of Appreciation" by the Division of Production of the American Petroleum Institute at its 30th annual meeting in Los Angeles, California recently. Two additional awards were made posthumously. Receiving the certificates, which are awarded to a limited number of men each year for outstanding services rendered to the Institute, were the following:

O. D. Donnell, former president and general manager of the Ohio Oil Company, Findlay, Ohio, national chairman of the Central Committee on Measuring, Sampling, and Testing Crude Oil.

Walter Samans, formerly with Sun Oil Company, Philadelphia, participant in the standardization program.

C. P. Dimit, vice president, production department, Phillips Petroleum, Bartlesville, Oklahoma, for leadership and service in Division activities.

John A. Ritter, Sun Oil, Dallas, Texas, for service on the Institute's vocational training program, district activities, drilling and production practice work.

J. C. Siegle, Youngstown Sheet and Tube, Houston, Texas, for work on the standardization program.

Paul D. Torrey, president, Lynes, Inc., Houston, service in engineering studies and district activities for the Division.

The posthumous awards were made to: George S. Bays, formerly with Stanolind Oil and Gas, Tulsa, for lengthy service in improving production methods; J. Jay Dunn, Ellwood City, Pennsylvania, National Tube, for work on standardization.

D. L. Trax

O. D. Donnell

Paul D. Torry

Walter Samans

John A. Ritter

C. P. Dimit

J. C. Siegle

Saudi Arabia Production

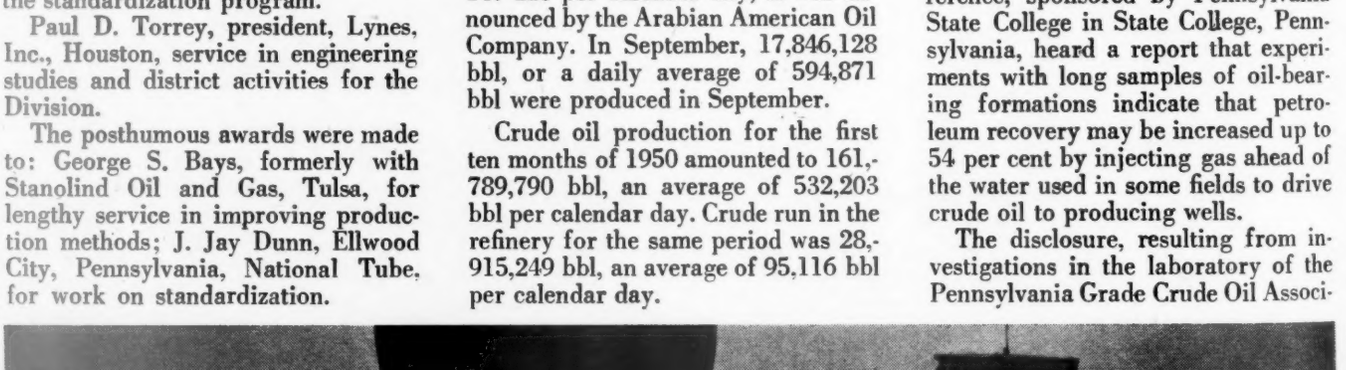
Crude oil production in Saudi Arabia during October amounted to 19,937,556 bbl, or an average of 643,147 bbl per calendar day, it was announced by the Arabian American Oil Company. In September, 17,846,128 bbl, or a daily average of 594,871 bbl were produced in September.

Crude oil production for the first ten months of 1950 amounted to 161,789,790 bbl, an average of 532,203 bbl per calendar day. Crude run in the refinery for the same period was 28,915,249 bbl, an average of 95,116 bbl per calendar day.

Gas Injection Claimed Aid to Oil Recovery

Oil producers and engineers meeting at the 14th annual technical conference, sponsored by Pennsylvania State College in State College, Pennsylvania, heard a report that experiments with long samples of oil-bearing formations indicate that petroleum recovery may be increased up to 54 per cent by injecting gas ahead of the water used in some fields to drive crude oil to producing wells.

The disclosure, resulting from investigations in the laboratory of the Pennsylvania Grade Crude Oil Associ-



Canadian Oil Men Meet. Officers of the Oil Technical Society of Alberta, Canada meeting in Devon are: Vice president, J. F. Langston, Denton-Spencer Company Limited; treasurer, Bert Corey, General Petroleums Limited; principal speaker, Charles Labery, National Tank, Tulsa, Oklahoma; vice president, Paul C. Evans, Canadian Gulf; directors, Jack Godwin, National Tank, Edmonton, and W. M. Reed, Halliburton Oil Well Cementing; Edmonton program committee, George Decker, Schlumberger; and entertainment committee, Jack Sparks, Halliburton.

ation at Bradford, Pennsylvania, was made in a paper by Dr. J. N. Breston, laboratory chief, and his associates, Joseph Saxon, Jr., and R. M. Macfarlane.

The paper on gas injection explained that the procedure involved the establishment of a high "free gas" saturation in the oil sand sample, or core, after the natural production phase and just prior to beginning the water flood. It was found that only a small quantity of gas was necessary to achieve the additional oil recovery. The gas drive, it was reported, caused a thorough oil removal throughout the core but also left it in condition for further oil recovery by water flooding. It was concluded from these experiments, performed on both Bradford type sands and Venango sands, that if such methods of oil recovery could be made applicable to the field it would mean greater oil recovery per acre and a reduction of the oil left in the sand to a new low point.

Water-flooding Project Is Begun in Montana Field

Carter Oil Company has begun the Rocky Mountain region's first water-flooding project for increasing oil production. At Cutbank Montana a $250,000 project will be undertaken in the Lander sandstone reservoir at a depth of 2900 ft according to O. C. Schrop, president, Carter Oil. The firm will drill four input wells for water injection as soon as equipment can be moved into the field. Additional wells for water supply will be drilled. The reservoir was developed in the mid-30's but has been declining in production since 1945.

Hydrafrac Ups Production

The Carter Oil Company has completed a good oil producer in Seminole County, Oklahoma. After hydrafrac treatment at its No. 5 Strothers, the well flowed 183 bbl of 37.7 gravity oil in 6 hr through a 1 in. choke from perforations in the Lower Calvin sand between 2549½-57½ ft. Gas-oil ratio was 1242 to 1. Plugged back depth was 2569.

Transfers

Milton H. Kuhleman, exploration geologist for The California Company, was recently transferred to Jackson, Mississippi from New Orleans, Louisiana.

Joe A. Perry, formerly production engineer at Victoria, Texas for the former Barnsdall Oil Company, was transferred to Alice, Texas with Sunray Oil Corporation. He will maintain his same capacity.

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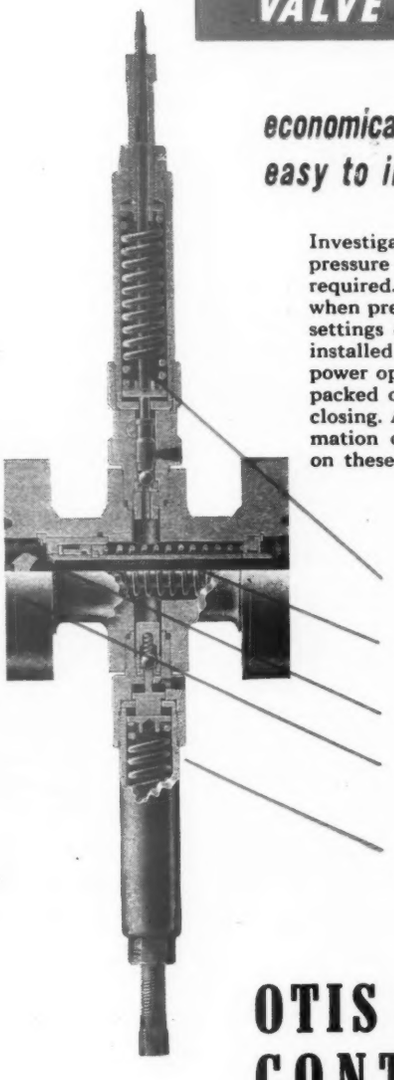

High-pressure pilot assembly, proved in hundreds of Type X Otis Surface Safety Valves, is exposed to same pressure that exists in safety valve bore.

Flow shut-off mechanism is patterned after Otis Tubing Safety Valve. A spring on the assembly holds the valve open against the thrust of the pressure differential.

Valve is actuated and snaps shut when high- or low-pressure pilot is subject to pressure variations beyond set limits.

Valve body is designed for adapting an auxiliary "Type M" pilot assembly (not illustrated) and an outside by-pass line which allows safety device to be installed upstream of surface choke but activated by downstream pressure.

Low-pressure pilot assembly is similar to high-pressure pilot in construction and operation. All working parts subjected to well fluids are made of high-grade stainless steel or Monel.

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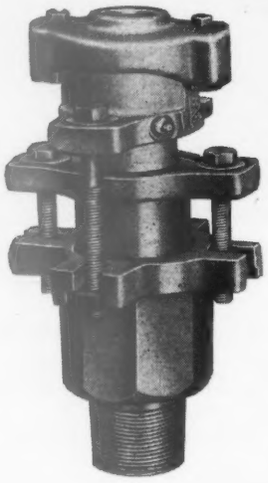

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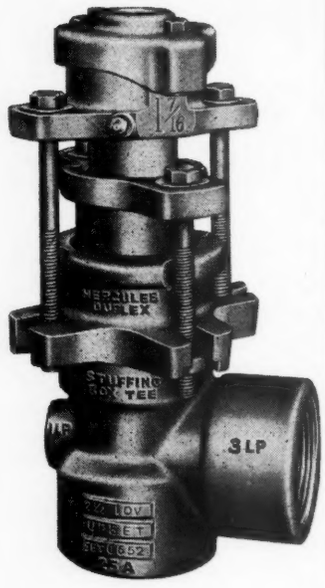
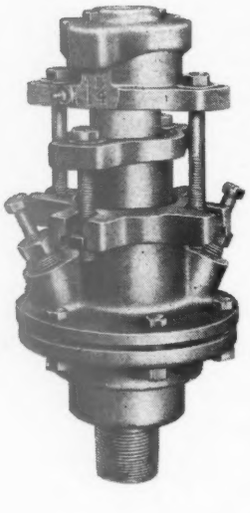


A double packed Stuffing Box for use under most adverse pumping and flowing conditions (below). Be sure to order Type A-123-SBDP.



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Affidavits Required With Directional Survey Data

The Texas Railroad Commission has issued an order that affidavits accompany directional survey data submitted on any well being whipstocked and/or deviated from the vertical, and for which a directional survey is required. Affidavits shall include the following information:

1. Name of the person performing and/or supervising survey.
2. Name of employer of person.
3. Position person holds with the firm.
4. Date on which survey was performed.
5. Detailed description of the nature of the survey.
6. A complete description of the well including operator, fee owner, well number, land survey, field name, county, and state.

Affidavits must be subscribed and sworn to before a notary public.

Regional Exploration Meet Held in Fort Worth, Texas

The Fort Worth Geophysical Society, Fort Worth Geological Society, Dallas Geophysical Society, Geophysical Society of Tulsa, Oklahoma, the Ark-La-Tex Geophysical Society, and the Permian Basin Geophysical Society sponsored a regional exploration meeting in Fort Worth, Texas recently.

General theme of the meeting was the exploration problems, both geological and geophysical, of a number of oil provinces in the south-central United States. J. L. Morris, president of the Fort Worth Geophysical Society, opened the meetings, and Ira H. Cram, vice president of Continental Oil Company, gave the opening address.

AAODC Revises Two Manuals

A complete revision of Manual of Accounting Practices and Procedures for the Oilwell Drilling Contractor and of the Costing Guide of Items and Materials Used in Oilwell Drilling, has been published by American Association of Oilwell Drilling Contractors.

Revision of these manuals was carried out under the Association's Accounting Committee, of which C. H. Todd, R. W. Rine Drilling Company, Wichita, Kansas, is chairman, and C. H. Phifer, L. D. Cain Drilling Company, Houston, Texas, is vice-chairman. W. K. Powell was employed as a consultant in making the revisions.

The new manuals replace those originally published in 1945 and give recognition to advances, improvements, and trends in cost accounting within the drilling industry since that time.

Quarles Speaks to Dallas, Texas Geologists

Miller Quarles, Jr. of Houston, Texas, district supervisor of United Geophysical Company, addressed the Dallas Geophysical Society recently. His subject was the Salt Ridge Hypothesis on the Origin of Texas Gulf Coast Type Faulting. Quarles, who specializes in problems of faulting, has been with United Geophysical since 1941.

Malco Refineries Buy Fred M. Manning, Inc.

Malco Refineries, Inc., of Roswell, New Mexico has bought Fred M. Manning, Inc., drilling and exploration firm of Denver, Colorado. Included in the sale were 255 producing wells with an average daily production of about 6500 bbl, according to press reports, a large oil transport company, and four pressure maintainence plants in Texas. Robert O. Anderson, Malco president, said the drilling company operations will be continued from the Denver office.

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THE PETROLEUM ENGINEER

WHAT'S DOING IN DRILLING

Ellenburger Zone Hit In New Mexico Well

Gulf Oil Corporation has opened the Ellenburger zone for production in the Teague field of Lea County, New Mexico at its No. 1 E. C. Hill. Previous field production is from the Simpson. The well flowed 37 bbl of oil in 2 hours through ¾-in. choke and later did 166 bbl in 7 hours through same choke, with gas-oil ratio of 308-to-1, and was completed. Ellenburger was topped at 9685.

Phillips Drills Second Golden Eagle Unit Well

Phillips Petroleum Company and Associates have completed a second well on their Golden Eagle unit in Hot Springs County, Wyoming. This No. 2 Golden Eagle was completed for 1066 bbl of 48.4 gravity oil per day on 15/64-in. choke from the Embar formation, which was perforated from 8890-8930 ft. The well was drilled to the total depth of 9,339 ft and plugged back to 9128 ft.

Golden Eagle Well No. 2 is situated one-half mile north of Phillips and Associates' Golden Eagle Well No. 1, which was completed in the Tensleep formation and flowed 489 bbl of 43 gravity oil in 24 hours through a one-inch choke.

Vasen Well Below 18,000 Ft

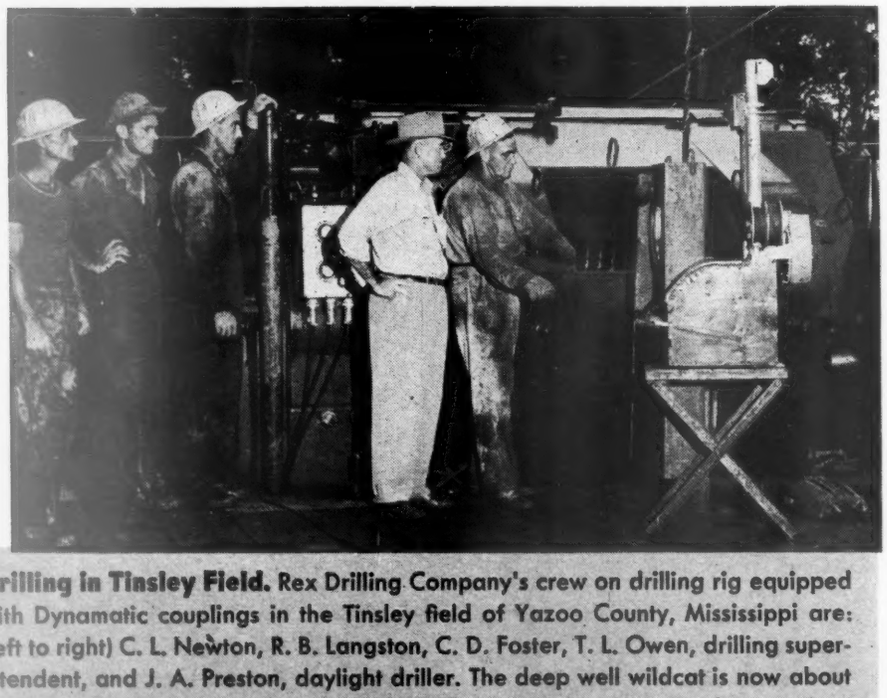
George Vasen 1 Tung Oil Corporation Stone County, Mississippi wildcat, is coring below 18,764 ft, making it the second deepest well in the world. It is reported that at present depth, cores include black shale described as "oily" in appearance, indicating that the Smackover formation has been passed and new formations are being penetrated.

Ohio Gas Well Completed

Foraker Drilling Company has a big gas well from the Clinton formation in Perry County, Ohio. The Clinton was topped at 3730 ft and drilled 35 ft in the formation where an open flow 1,000,000 cu ft of gas, natural, was recorded after blowing open for 4 hours.

New Well Testing In Dilworth Field

Dilworth field in Southwest Texas has another oil well at H. R. Smith and American Republics Corporation's No. 2 J. C. Dilworth, Jr. The well was drilled for a total depth of 5876 ft, with several indicated pay zones. Oil production was indicated during drilling operations and confirmed by drill stem tests at 5295-354 ft, 5402-24 ft, and 5424-40 ft.



Drilling in Tinsley Field. Rex Drilling Company's crew on drilling rig equipped with Dynamatic couplings in the Tinsley field of Yazoo County, Mississippi are: (left to right) C. L. Newton, R. B. Langston, C. D. Foster, T. L. Owen, drilling superintendent, and J. A. Preston, daylight driller. The deep well wildcat is now about 6000 ft deep and projected to 12,500 ft. The rheostat controls for the couplings on each engine are on the control box behind the superintendent.

Great Lakes Acquires New Mexico Acreage

Great Lakes Oil and Chemical Company has acquired a substantial block of acreage in the San Juan Basin of New Mexico, which will supply the company with sizable gas reserves. This acquisition, Charles S. Hale, president, said, is situated in an area presently being developed by the Delhi Oil Company, Western Natural Gas Company, Hancock Oil Company, Southern Union Gas Company, and other large gas operators. El Paso Natural Gas Company was recently granted a permit by the Federal Power Commission to construct a gas line from the area to California.

The new block consists of approximately 4800 acres, on which is situated a complete gas well that flowed considerably in excess of 2,000,000 cu ft of natural on a 24 hr test. Estimated output after shooting, Hale continued, will be in excess of 15,000,000 cu ft per day. The gas has a high Btu content and is rich in distillate with pressure far in excess of pipe line requirements.

Michigan Gas Well Flows From Berea

Charles Hoffman has added the third and largest Berea gas well in Cedar Creek field, Muskegon County, Michigan with his No. 1 Gritzner Estate. The new well was bottomed in the Berea at 1135 ft, and was gaged at 4,100,000 cu ft of gas a day. Top of objective sand was logged at 1125 ft. Production showed from 1 ft in the section to the total depth. The discovery well is about a mile southwest of this newest producer, and was gaged at 750,000 cu ft of gas a day.

Well Flows 359 Bbl in 15 Hr

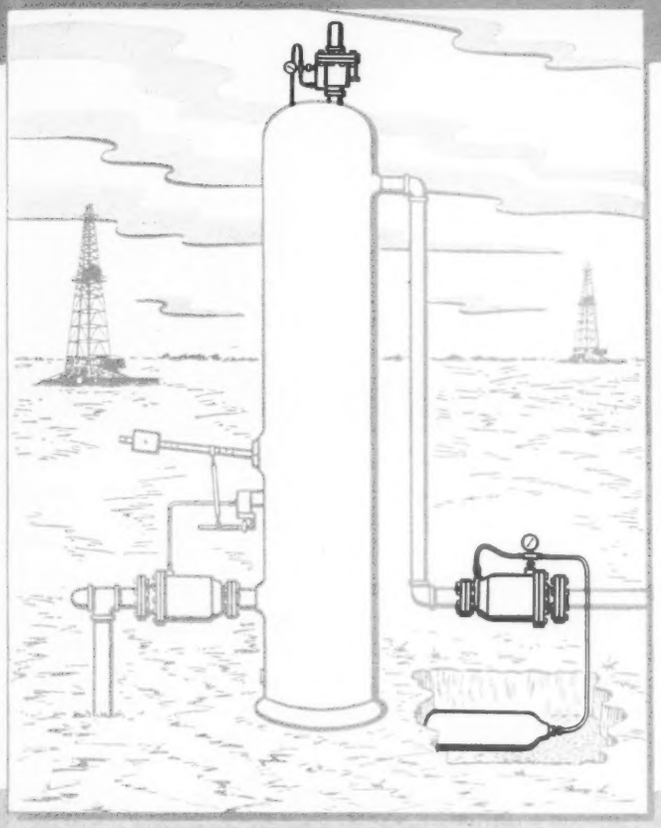
Shell Oil and Continental Oil Companies have a new well in Beckham County, Oklahoma. Plugged back depth of the No. 3 Woods is 10,129 ft. It flowed 359 bbl of oil with 375,000 cu ft of gas in 15 hr through a 22/64-in choke.

New Well in Cushing Field

E. B. Harwell and A. B. Whitten have a good producer in the old Cushing field of Creek County, Oklahoma. Their No. 2 Morton was given hydrafrac treatment in the sand between 2499-2530 ft and the well then flowed 565 bbl of oil in 24 hours. It is testing.

GROVE

MODEL 888 PRESSURE LOADED RELIEVER



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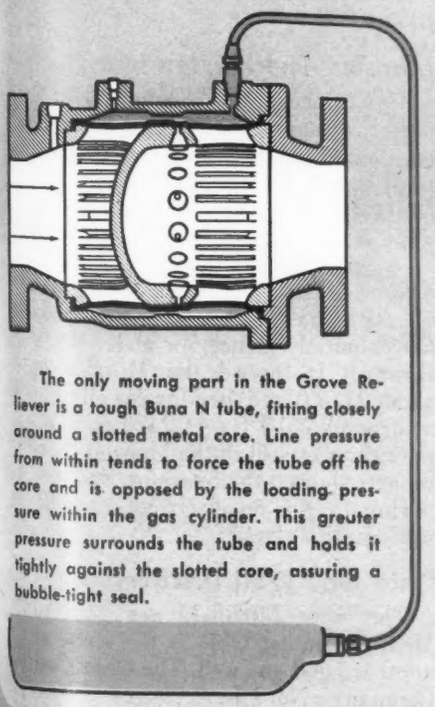
Specify Grove Model 888 Relievers with the proved Flexflo principle on your Separators for the best in efficient, trouble-free service.

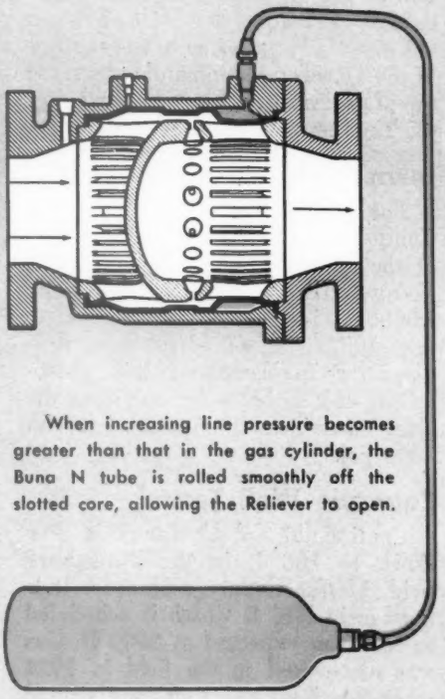
flexflo LETS PRESSURE DO THE WORK

CLOSED POSITION



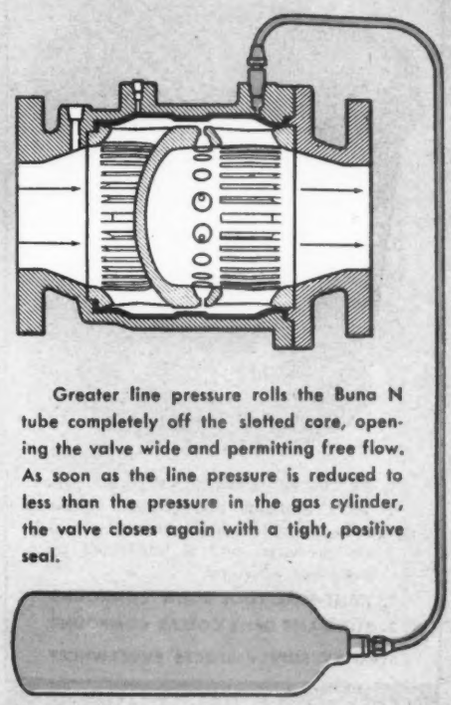
The only moving part in the Grove Reliever is a tough Buna N tube, fitting closely around a slotted metal core. Line pressure from within tends to force the tube off the core and is opposed by the loading pressure within the gas cylinder. This greater pressure surrounds the tube and holds it tightly against the slotted core, assuring a bubble-tight seal.

PARTIALLY OPEN POSITION



When increasing line pressure becomes greater than that in the gas cylinder, the Buna N tube is rolled smoothly off the slotted core, allowing the Reliever to open.

WIDE OPEN POSITION



Greater line pressure rolls the Buna N tube completely off the slotted core, opening the valve wide and permitting free flow. As soon as the line pressure is reduced to less than the pressure in the gas cylinder, the valve closes again with a tight, positive seal.

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Falcon Gets Supply Award

Falcon Seaboard Drilling Company, Tulsa, is the first drilling contractor to win the Joseph A. Holmes Safety Award. Theodore N. Law, Falcon Seaboard president, received the award from C. W. Seibel, U. S. Bureau of Mines, at the tenth annual meeting of American Association of Oilwell Drilling Contractors in Tulsa, Oklahoma.

The award was presented for a record 10 years of no fatalities by Falcon Seaboard, from January 1, 1940, to January 1, 1950, in which 939 wells were drilled for a total footage of 2,745,610 ft. During this time, the company had an average of 200 employees who worked a total of 3,456,000 man hours.

Colorado Gas Well Drilled

British-American Oil Producing Company has completed the Linde No. 1 as a 16,000,000-cu ft gas producer in Logan County, Colorado. Situated in the Armstrong pool, the well is producing from D sand between 5258-5274 ft. It is a northeast offset to the discovery well, the Segele No. 1, which was completed for 58 bbl per day of oil with some water from the J sand. D sand in the discovery showed some gas.

Falcon Seaboard president, Theodore N. Law (left), receives safety award from C. W. Siebel. At rear, J. L. Stauss and C. W. Alcorn, Falcon Seaboard vice presidents, look on. The company has had no fatalities in 10 years.

Western Deepens Wyoming Well

Western Oil Associates of Denver, Colorado are going to deepen the well drilled by Wyoming Oil, Morton Oil Company, and Woodward Oil, Inc., Washakie County, Wyoming. Between 40 and 50 bbl of 34 gravity oil is being produced by Nowood's initial completed well, Bay Petroleum Corporation's Zeigler et al, which is producing from the lower Tensleep at a level about 80 ft lower than the bottom of the Wyoming Oil test. Objective of deepening the well, Western Oil Associates states, is to test the rest of the Tensleep section and at least the top of the Amsden, immediately below the Tensleep.

Texas Pool Gets Extension

The Texas Pacific Coal and Oil Company has a northwest extension of the Richardson pool in Montague County, Texas at its No. 2 Alfred Kleihans. The well was completed to flow 125.88 bbl of 42 gravity oil in 6½ hours for calculated daily potential of 460.25 bbl after acidizing the Caddo lime from 6086 to 6095 ft with 3000 gal.

Colorado Well Tested

Continental Oil Company is now down to 188 ft in the Thornburg field, Moffat County, Colorado. It is the Lewin No. 1, which is scheduled to Madison expected at 6900 ft. Gas was discovered in the field in 1924 when Marland Oil Company drilled the Wymore No. 1. The well developed 60,000,000 cu ft of gas per day from Dakota at 2064 ft.

Carter Completes Producer In East Sparks Pool

Carter Oil Company has completed a high-gravity producer in the East Sparks pool of Lincoln County, Oklahoma at its No. 4 Bowman Heirs. It is producing from the Prue sand. Bottomed at a plug-back depth of 3564 ft, casing was perforated at 3547-62 ft and following hydrafrac treatment of the sand, the well flowed 247 bbl of 41.2 gravity oil in 12 hours through a ½-in. choke. Gas volume was 175,000 ft per day for a ratio of 708-to-1.

Morales Field Extended

The Clayton pool in Morales field western Cuyama Valley, California, may have a ¼-mile northwest extension. Discovered early last summer, a total of 11 Morales sand producers were completed to prove about 160 acres oil productive before development was suspended about 2 months ago. Richfield Oil Corporation has the potential extensioner at its No. 1 Howard. It topped the Morales at about 2175 ft and the Morales oil sand at around 2310 ft. At 2478 ft it reportedly was still in the Morales. Last reports showed the operator was preparing to run an electrical log with total depth at 2642 ft.

Ohio Gas Well Discovered

The West Litchfield gas pool in Medina County, Ohio is the scene of another good gas well. The Ohio Fuel Company's No. 1 L. A. Starr has been drilled down to the Clinton sand and is reported at 2611-23 ft, with a natural open flow of 5,740,000 cu ft.

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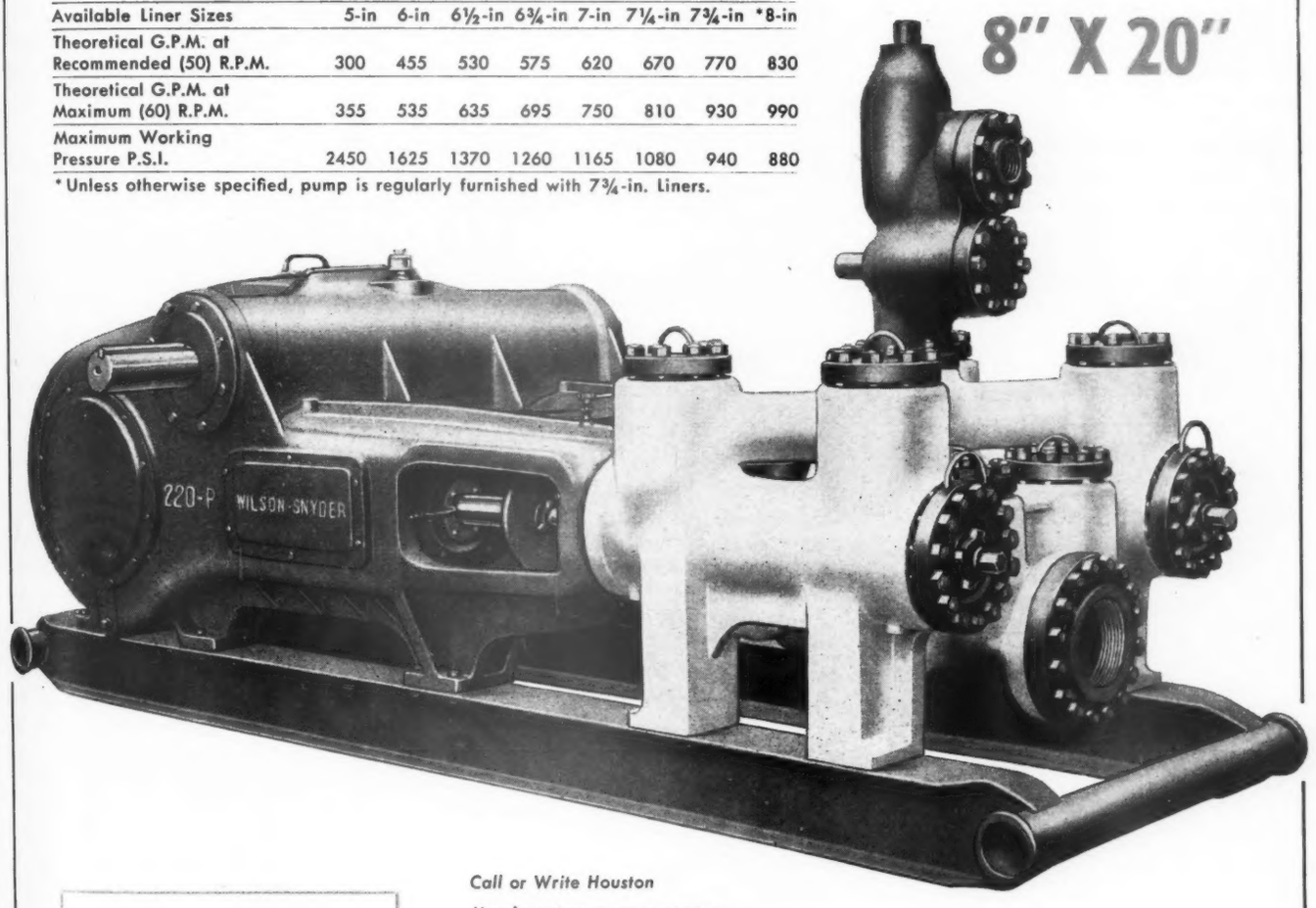
Theoretical G.P.M. at Maximum (60) R.P.M.	355	535	635	695	750	810	930	990
Maximum Working Pressure P.S.I.	2450	1625	1370	1260	1165	1080	940	880

*Unless otherwise specified, pump is regularly furnished with 7¾-in. Liners.



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EXPLORATION ACTIVITIES

Shell May Have New Oil, Gas Pool in Colorado

Shell Oil Company's No. 1 C. F. Green in Logan County, Colorado has either opened a new oil and gas pool or has an extension of production two miles from a British American Oil Producing Company producer. The well topped the Muddy sand at 4689 ft. A core from 4871-96 ft showed 14 ft of sand with light stain, nine feet of sand with shale streaks, and two feet of shale, slightly sandy. On drill stem test between 4871-97 ft with tool open two hours, it sprayed oil and gas for 45 min while coming out and unloaded the pipe. Recovery was 4 bbl of 37.9 gravity oil. On drill stem test between 4901-15 ft, with tool open one hour, recovery was 10 ft of mud.

Wildcat Proved Good In West Central Texas

A new oil pool has been opened in Eastland County, Texas, by David T. Roche, Austin, Texas, and the Texinia Corporation. The new Marble Falls pool was discovered at the No. 1 Gresham, which was drilled to 3230 ft. After treating with 1000 gal of acid, the well was swabbing at the rate of 6 bbl of fluid per hour, 70 per cent of which was 48-gravity crude, the remainder acid water.

Oil Signs at Kansas Well

Prospects of oil have been found in Thomas County, Kansas, at Westgate-Greenland Oil Company's No. 1 Herbel, a rank wildcat. Showings were made in the Fort Scott member of the Marmaton group, where a drill stem test yielded 35 ft of slightly oil cut mud. Top of the prospective production zone was logged at 4468 ft.

Trico Has Big Gas Well

Trico Oil and Gas Company's new well, the Veon No. 72 in the San Joaguin Valley, California, has been completed for 1,000,000 cu ft of gas a day. The well was drilled to 5822 ft, but was completed at 4720 ft.

Production in Iran

Anglo-Iranian Oil Company, Ltd. has reported a total of 2,396,000 long tons of crude oil were produced in Iran in September. Total production for the period January 1 to September 30, 1950 was 23,693,000 long tons.

Sunray Seeks Oil In Water

Immediate exploratory development on 3520 oil prospect acres adjacent to the Mustang Island oil field of Nueces County, Texas, is planned by Sunray Oil Corporation. The Sunray tract first to be tested is a 320-acre lease offsetting the Renwar No. 1, now being completed and showing production from two gas distillate and two oil bearing sands. On potential test the Renwar well produced from 7520 ft, at the rate of 14 bph through ¼-in. choke.

The Mustang Island field was discovered in 1949 when the Atlantic-Tidewater No. 1 on State Tract No. 436 was carried to 9526 ft. This well penetrated six gas distillate and one oil sand in the Frio section at various producing depths from 6800-8000 ft. Since the field discovery well was brought in, 8 oil wells and 5 gas-distillate wells have been completed by the various operators. At least 4 marine-type drilling rigs are active in the area at the present time, operating from bay surface depths of from four to 12 ft.

Netherlands Survey Made

In the Netherlands, N. V. Nederlandse Ardolie Mij. (jointly owned by Shell and Jersey Standard) has almost completed a survey of the entire country and has 6 drilling rigs employed in exploration work. The Schoonebeck field now meets 30 per cent of the domestic demand. Output this year is estimated at 700,000 metric tons.

Gas Discovery Made In Northwest Alberta

Fifteen Canadian independents and the Benedum and Trees interests of Pittsburgh, Pennsylvania have made a natural gas discovery at a wildcat well in northwest Alberta. The gas discovery well, Pacific-Valleyview No. 1, is about 50 miles south of the Normandville Devonian oil discovery and 65 miles east of Grande Prairie. Valley View No. 1 found natural gas in the Peace River sands, an equivalent to the Viking sand of Central Alberta and the Bow Island sand in the southern sector of the province. The gas sand was topped at 2955 ft, and drill stem test from 2942-2970 ft gave a maximum flow rate of 3,400,000 cu ft of natural gas daily.

Nebraska Gets Two New Gas Discoveries

The Macauley-Dorough Anderson No. 1, south Cheyenne County, Nebraska flowed at the rate of 3,280,000 cu ft of gas on a 33-min drill stem test between 4662-4672 ft. Estimates of potential production ran from 15 to 20,000,000 cu ft per day, open flow. Production is from the first or "D" sand. The well was drilled to 5288 ft in Morrison and plugged back to 4672 ft. A small gas discovery has been made in Cheyenne County, by Ohio Oil Company at its Fender No. 1, near Sunol. Producing from the "D" sand, the well was drilled to 6814 ft through the Reagan sand. Production, rated at 1,700,000 cu ft of gas per day, is from perforations between 4350-4360 ft.

New Mississippi Discovery

A Wilcox discovery has been made in Jefferson County, Mississippi, by Robert Oil Company and Lyle Cashion. It is the No. 1 Davis heirs, which was completed from perforations at 5535-37 ft in the Artman sand. On potential test it flowed 260 bbl of 44 gravity oil in 2 hr on ¼-in. choke.

Skiles Opens Indiana Pool

Skiles Oil Company appears to have discovered a new pool in the St. Phillips area, in Vanderburgh County, Indiana, at its No. 1 Shrode. The well, ¾ to 1 mile west of production of the Belknap pool, has good saturation in the Cyress sand at 2354-65 ft.

Louisiana Adds Oil Sector

Pan Am-Southern Corporation and Austin Stewart have opened a new oil field in Catahoula Parish, Louisiana at their No. 1 Gillis, two miles west of Riverfield. On initial test it flowed 120 bbl of 40 gravity oil a day through a ⅛-in. choke. Gas-oil ratio was 200-to-1. Pay is through 8 perforations from one foot of zone at 4638½-39½ ft.

Gas Well Completed In Morgan County, Colorado

J. M. Huber Corporation has recovered 4,000,000 cu ft of gas per day in the Lee area of Morgan County, Colorado at its Government-Smith No. 1. Total depth is 5536 ft, 7 ft into the Dakota. Muddy, between 5442-5455 ft, tested 1,000,000 cu ft per day.

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Two Montana Wells Make Good Showings

Farmers Union Central Exchange topped the sand at 4811 ft and found shows of oil in the top of the formation, at its No. 1 Sawyer in Rosebud County, central Montana. The well is 15 miles southeast of Ragged Point field and 18 miles northeast of Melstone field. At a total depth of 5267 ft, while the crew was pulling pipe for a change of bits, the well began to unload, blowing mud and water over the top of the derrick. There was evidence of gas and some oil shows in the sump. A test between 5227-5277 ft, open two hours, recovered 3355 ft of 31.6 gravity oil and 100 ft of oil-cut mud. Production was estimated at 25 bbl per hour.

The Texas Company's State No. 1, bottomed at 4473 ft, topped Amsden at 4303 ft. A drill stem test between 4419-4434 ft, open two hours, recovered 90 ft of oil cut mud, 10 per cent oil. It is 7¼ miles southeast of the Farmers Union well.

New Members Inducted. Ted Forsyth presents Sidney Shuman, Fluid Packed Pump Company and Glen Merkley, National Supply Company, their shingles and pins as they are inducted into the Los Angeles Chapter of Nomads.

Big Gasser Proved In San Juan Area

Stanolind Oil and Gas Company has reported a test flow of 40,000,000 cu ft of gas at its No. 1 Ute-Ignacio in the San Juan basin well just across the New Mexico line in Colorado's La Plata County. Frank Barnes, commission geologist, said the flow was from the Morrison formation, which also underlies all of northwestern New Mexico. Only small showings of gas and oil have been previously reported.

New Illinois Oil Area

A new Illinois oil producing area has been discovered by the Vandenbark Brothers and Coy Oil Company. Situated in Gallatin County, the No. 1 Lawrence Drone, is cleaning out to test the Aux Vases sand at 2727 to 2732 ft. Total depth is 2746 ft. A drill stem test from 2700 to 2746 ft, recovered gas in 11 min, and flowed clean oil in 30 min. This well is one and one-half miles from other wells.

Prospecting Party in Papua

An oil prospecting party left London by air recently to undertake operations in Papua on behalf of the Australasian Petroleum Company (in which the Anglo-Iranian Oil Company is partner with American and Australian interests). The party consisted of 8 members of Seismograph Services, Ltd., who are contractors for this work. Technical equipment weighing 2000 lb will also be transported by air.

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Oil and Gas Area Is Discovered in Louisiana

Richardson and Bass of Fort Worth are opening oil and gas production in the Cox Bay area of Plaquemines Parish, South Louisiana at the No. 1-H State. The well was drilled to 13,429 ft with 7-in. liner to 13,421 ft. A test at 8980 to 8984 ft returned gas and operators now are completing in an oil sand in perforations from 9104 to 9114 ft.

Humble Opens New Pool In Midland County, Texas

With completion of its No. 1 T. O. Midkiff, Humble Oil and Refining Company has opened a new oil pool in Midland County, Texas, 24 miles southeast of Midland. Flowing from the Spraberry sand of permian age, the well pumped 80 bbl of 33.8 gravity oil plus some water with pay from 7302 to 7520 ft.

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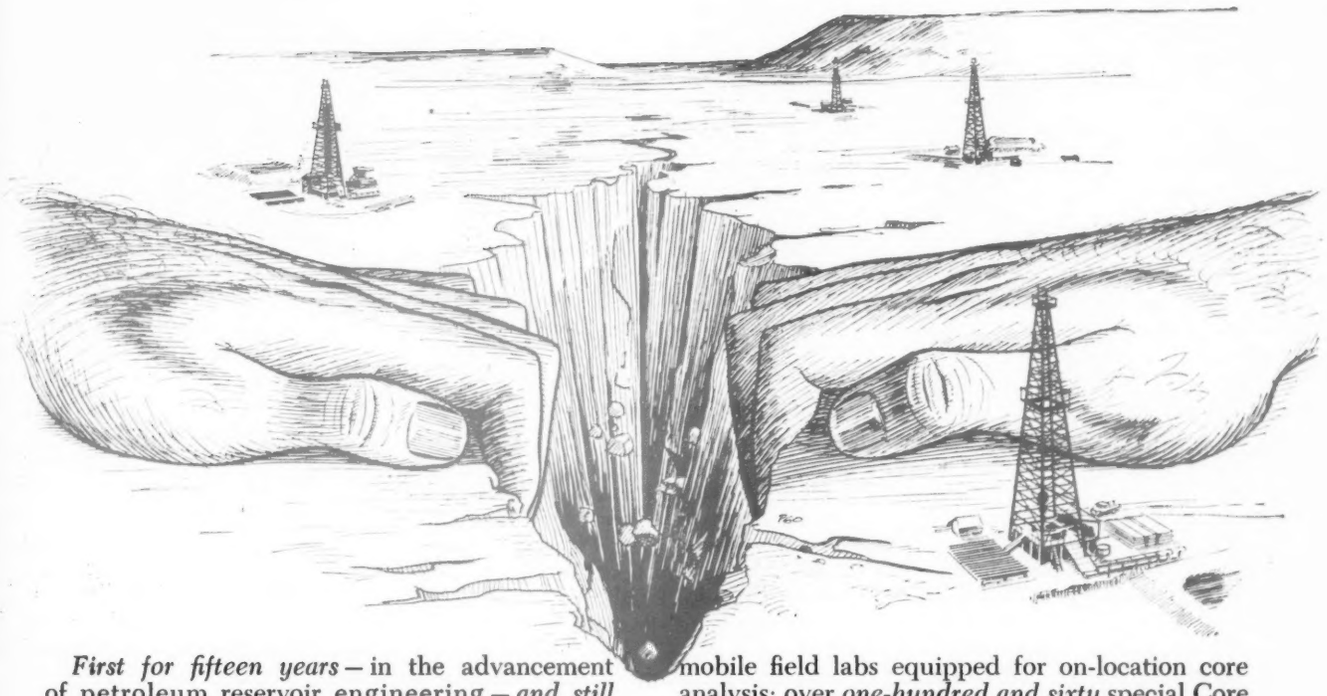

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PETROLEUM RESERVOIR ENGINEERING

Running tour with men in the industry

▸ **J. R. Fanshawe,** head of exploration activities for Seaboard Oil Company in the Rockies, has been elected president of the Wyoming Geological Association at a recent meeting of the group. Other new officers are: **John R. Miller,** Pacific Western, first vice president; **F. A. Thurman,** Pure Oil Company, second vice president; **Helen Mann,** Continental Oil Company, secretary, and **M. D. Hubley,** Stanolind Oil and Gas, treasurer.

▸ **Chester Donnally,** former supervisor of Texas operations for Western Geophysical Company of America, has been appointed vice president of Grant Oil Tool and MacClatchie Manufacturing Companies, in charge of Mid-Continent sales and service, with headquarters at Dallas, Texas. Donnally was graduated from Southern Methodist University with a B. S. in geology, and in 1930 was employed by Geophysical Service, Inc., in the Dallas area. Four years later he transferred to Western Geophysical Company and after some time as party chief in the San Joaquin Valley territory of California, was returned to Dallas to supervise Texas operations.

▸ **Jackson M. Barton,** formerly director of exploration for the Cooperative Refinery association in Kansas City, Missouri, has been appointed manager of Deep Rock Oil Corporation's geological department. A native Oklahoman, Barton received his B.S. degree from the University of Oklahoma in 1938, then worked for Magnolia Petroleum Company a year before continuing graduate studies at Yale. He returned to Magnolia in 1941 and served the company both in Oklahoma and West Texas for five years.

In 1946, he joined the Cooperative Refinery Association as division geologist at Wichita, Kansas. Later he moved to Kansas City as chief geologist for Cooperative.

▸ **Claude W. Pierce** has been advanced to a new position in the production department of the General Petroleum Corporation. He was named superintendent of water disposal, a newly-created post. He will work with the three production divisions in California on problems involved in the disposal of oil field wastes and the design and construction of injection plants for underground disposal of salt water.

A veteran of 24 years with General Petroleum, Pierce has been resident engineer for the production department's southern division since 1942. He joined the company while still a student at the University of California and worked as a roustabout and rig builder. He became an assistant engineer in 1938.

▸ **R. E. Minnis, Jr.,** will be transferred from Shawnee to Oklahoma City, Oklahoma, by Phillips Petroleum Company to become district geologist for the combined Oklahoma City-Shawnee districts.

Minnis has been with Phillips since 1942 and for three years was district geologist at Wichita, Kansas. Since 1945 he has held the same position at Shawnee.

W. E. McMurtry, also of the Shawnee office, will become assistant district geologist of the Oklahoma City-Shawnee districts and will also be situated in Oklahoma City.

Spindletop Celebration. Displaying hand-painted ties publicizing the Spindletop 50th anniversary celebration to be held in Beaumont, Texas next month are: John W. Newton, Magnolia vice president and manager of refining; Phil S. Justice, Sun Oil land department manager; and Scott W. Myers, independent operator.

▸ **R. C. Frederick** has been appointed chief of the gas supply and disposition branch of the production department staff for Gulf Oil Corporation in Pittsburgh, Pennsylvania. Frederick

R. C. Frederick

studied geology and engineering at Ohio State University, and received a Bachelor of Science degree from Denison University in 1926. He joined Gulf as a clerk in the executive department, Tulsa production division in 1927, and until his new appointment was staff assistant to P. H. Bohart, vice president in charge of that office. He is a member of the American Petroleum Institute, the American Institute of Mining and Metallurgical Engineers, and was prominent in the Tulsa Chamber of Commerce and Engineers' Club.

Carl J. Maki has been appointed assistant to Frederick. He was originally employed by the Mene Grande Oil Company, a Gulf subsidiary, in 1945 to form the gas department, and has served in the capacity of superintendent of that department in Eastern Venezuela until his new appointment. He is a graduate of the University of Minnesota.

▸ **Captain Robert H. Meade,** CEC, U. S. Navy, has been made the director of Naval Petroleum Reserves. Commodore W. G. Greenman, U. S. Navy, the present director, has been assigned other duties in the Office of the Secretary of the Navy for a short period before he retires from active duty in the Navy.

Captain Meade, a graduate of Annapolis, class of 1926, and Rensselaer Polytechnic Institute, has served in the Civil Engineer Corps, U. S. Navy, since 1929 in a variety of assignments involving engineering and contractual relations with private industry.

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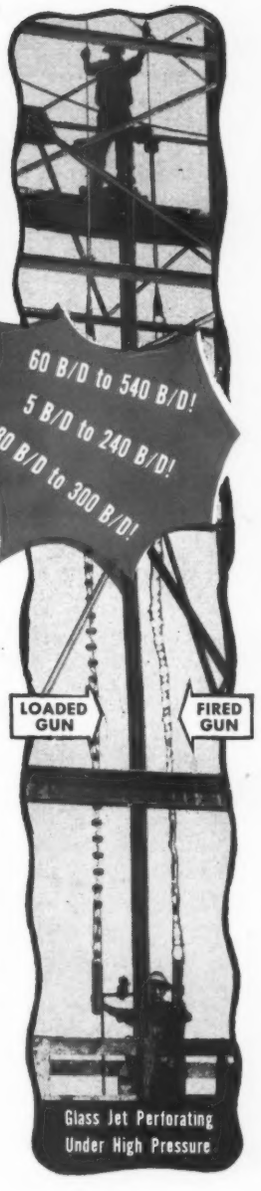

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R. Ogarrio, vice president and director of The Texas Company will retire on December 31, 1950. At that time he will have completed 34 years of service with the company, which began in 1916 in the company's operations in Mexico. In 1925 he was appointed general manager of The Texas Petroleum Company, operating in Colombia and Venezuela. In 1928 he was elected vice president in charge of production, and in 1931 he was elected to the board of directors. Ogarrio will establish residence in Mexico in December and will continue in a consulting and advisory capacity primarily on the company's foreign activities.

Nomad Visitors at the November meeting in Houston, Texas, are: Front row, J. M. Ribble, Phillips Petroleum, Bartlesville, Oklahoma, and C. B. Caldwell, Harrisburg Sales and Service, Houston; back row, Bill Lewis, Petroleum Industry Consultants, Caracas, Venezuela; Jess C. George, Socony-Vacuum, Caracas, and George E. Greiner, Phillips, Bartlesville.

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John H. Jennings has joined the Deep Rock Oil Corporation's staff as evaluation engineer. He had been petroleum engineer for the Ohio Oil Company's Tulsa division for the past 5 years. Jennings received his petroleum engineering degree from the University of Pittsburgh in 1939, and soon after began work with Sunray Oil Corporation in Tulsa, Oklahoma. In 1942 he joined the Ohio Oil organization, and worked a year for the Mountain Fuel Supply Company at Rock Springs, Wyoming before being transferred to Ohio's Bakersfield, California division.

He left Ohio in 1944 to do private consulting work, but in 1945 rejoined the company in Tulsa.

T. E. Ockershauser, Oklahoma City, Oklahoma, has resigned from The Globe Oil and Refining Company after 3 years as engineer in charge of the Southwest Antioch Gibson Sand Unit. Prior to joining Globe, Ockershauser was with Shell Oil Company for 11 years doing drilling and production work in Kansas, Oklahoma, and Illinois. His future plans are indefinite.

James Monroe McCammon, warehouse supervisor for Magnolia Petroleum Company, died at his home in Dallas, Texas recently. McCammon had been with the Magnolia organization nearly 43 years, having begun with the company as an office boy at the age of 16. At the time of his death he had supervision over all of the company's material and warehouses in producing, natural gas, and transportation operations.

F. B. Carter, assistant to the director of exploration, General Petroleum Corporation, was elected president of the Pacific Section of the American Association of Petroleum Geologists at that organization's annual meeting in Los Angeles, California recently.

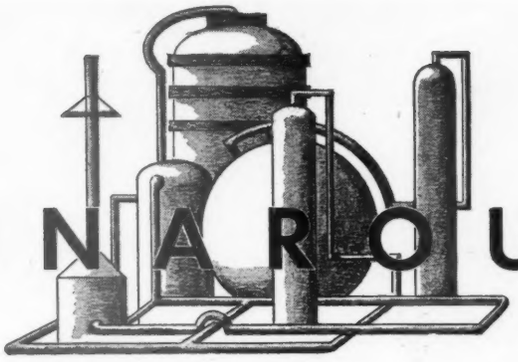
Robert Dyk, geophysical supervisor for General Petroleum in the San Joaquin Valley area of California, was elected president of the Society of Exploration Geophysicists, Pacific Section, at the SEG convention, which ran concurrently with the AAPG convention.

Carter joined General Petroleum in 1934 and was engaged in geological field work for 14 years before assuming his present post. Dyk came to General Petroleum in 1947 as a senior geophysicist. Both men are graduates of the University of California.

M. Darwin Quigley, Sinclair Oil and Gas Company, Salt Lake City, Utah has been elected president for 1950-51 of the Intermountain Association of Petroleum Geologists. Other officers are: **Robert E. Landon,** General Petroleum Company, vice president; **Richard R. Clawson,** treasurer, Standard Oil of California, and **H. V. W. Donohoo,** geophysics department, University of Utah, all of Salt Lake City.

Dean C. Wellman, formerly geologist with Shell Oil Company, has resigned to open a Rocky Mountain area office in Denver, Colorado for the Derby Oil Company of Kansas. Wellman was 6 years with Shell and with Pure Oil Company for 7 years in Mid-Continent and Rocky Mountain areas.

THE TURNAROUND



Petroleum Product Quality Demands

"What the SAE talks about today, the oil refining industry makes tomorrow," said one outstanding leader in the automotive-petroleum field several years ago. The truth of this statement, obvious even then, is far more evident now than at any past time. In fact, in some cases the refining industry makes the product first, and then the automotive industry moves to utilize it better—most of the time.

These facts are illustrated clearly in the deliberations in early November of the very important Fuels and Lubricants Activity (Division) of the Society of Automotive Engineers. This collaborative unit between the automotive and the oil refining industry includes the leaders in the liaison between the fuel and lubricant manufacturer and the products users, also between the automotive builders and the F and L builders.

Prominent in their deliberations were various phases of fuels and lubricants advances in technology and utilization. The 1949 fuel survey has shown that in studying private owner cars, at least 50 per cent of the cars on the road knock on the fuel that was found in their fuel tanks at the time the engines were selected for study. In blending higher octane number components such as diisobutylene, isooctane, etc.—having octane ratings of 100 or higher—with commercial fuels the blended fuels showed about the same anti-knock behavior as the commercial type fuels. Commercial fuels showed less increase in octane requirement to avoid knocking than did the special test (reference) fuels, in the presence of engine combustion chamber deposits. Interesting also is the finding that octane number requirement spread in engines that the makers consider "representative of their production is practically as great as that in engines already in general service." All these data indicate to the informed technologist the direction in which advances are going; they point the way for the efforts of the individual organization.

—A.L.F.

How Much is More Anti-Knock Worth?

Rating the effect, on performance number of engines, of the addition of anti-knock agents such as tetraethyllead to a given fuel "is substantially a constant fraction of the anti-knock quality of the base fuel," say Hesselberg and Lovell of Ethyl Corporation's research department. The "Performance Number" of an engine is defined by military technologist authorities as representing the knock-limited, indicated (power) output of an average supercharged engine operated on a given fuel as compared to that output obtained with isooctane, itself by definition having 100 octane number. This fact indicates the gains made possible either by increasing compression ratios to utilize higher octane ratings, or by the supercharge method of burning more fuel in the engine. Of the two methods, it was stated "the increase in knock-limited power accompanying an increase in performance number is SEVERAL times as great by the supercharge method as by the compression-ratio method." This gives an indication of the direction in which progress may go, especially in military type engines. Increases in knock-limited power output and in permissible compression ratio are proportional to performance number requirement increases, that is, to the proportional increase in effective anti-knock property.—A.L.F.

PLATFORMING
SHELL

Selection of Electric Motors

Refiner needs to know load characteristics, voltage factors, types in relation to operating conditions, economic factors.

JOE BENISH

THE continual growth of the demand for electrical energy has been due, in large part, to the increase in the use of electric motors. As new tasks for these motors have been created, new motors have been developed whose characteristics conform to the new requirements. Thus the best motor for one application may be inferior for a different application. As such a wide selection of motors is now available, the choice of the proper motor for a given job offers a better chance than ever before of increasing operating reliability and performance. At the same time, proper selection usually cuts costs. Although there are a number of problems that arise on special applications that could not be covered, an attempt will be made to discuss the major problems involved in motor selection.

Selection of Voltage

Wherever possible, a three phase, a-c system should be considered. Simplicity of construction of the motor with resulting low price, ease of transmitting the power required, and freedom from maintenance problems make the selection of three-phase desirable for any load requirement of more than a few horsepower. Though the use of 440 volts, 3-phase is probably the most common, 110 and 220 volt sources are used extensively. The use of 2300 volts, 3-phase is growing rapidly in the larger types of installations. Specification of motors for other, less standard voltages, will normally result in a price addition.

In the event that an application calls for the ability to change speed at will, direct current motors have a decided advantage. The drastic limitation arising from the choice of direct current motors in many plants, however, is the necessity to make provision for supplying the power required. Unless a special provision is offered by the utility company supplying power to the plant, additional equipment is required to generate or convert direct current. This fact, added to the problems of additional maintenance and higher purchase price, often makes the use of a less suitable a-c motor more advantageous. Common d-c voltages in use are 115, 230, 350, and 460.

For most applications requiring one horsepower or less, the single phase a-c motor has a definite advantage. It is commonly available in 110 and 220 volt ratings. There are single-phase motors exhibiting practically every desirable operating characteristic shown by the larger 3-phase motors (as well as many characteristics of the d-c motors.) Thus, in the smaller sizes, the single-phase motor has a virtual monopoly.

Regardless of the selection of voltage source, variation of that voltage under all operating conditions should be investigated. In the case of most a-c motors, variation of this voltage by more than 10 or 15 per cent will make the selection of a specially-designed motor necessary.

Load Characteristics

In general, the type of load determines the type of motor to be selected. Perhaps the clearest means of obtaining an understanding of the characteristics that a motor should have in order to be suitable for a given load is to compare the speed-torque curves of the load with those for various motors. A typical set of these curves is shown in Fig. 1. Obviously, the motor must be capable of starting the load. This means that the torque required to start the load must be less than that which the motor is capable of supplying at zero speed. Any excess of motor torque above this value is used up in acceleration. In Fig. 1, the torque OA is required to start the load, leaving an excess of torque AB for acceleration. The motor and load will then accelerate. The rate of acceleration will be dependent upon the amount of excess torque available, represented by lines such as CD and EF of Fig. 1, and upon the inertia of the motor and load. Acceleration will continue until that speed is reached at which the torque produced by the motor is just equal to that required by the load (point G of Fig. 1.) At this speed there is no excess torque and the motor will continue to run at this speed.

A fair approximation for the starting torque required by most sleeve-bearing machines is the assumption that this torque will be equal to one-fourth of the weight of all rotating parts acting at the radius of the journal. If the load exhibits any peculiar starting characteristics, it is well to select a motor that has high starting torque.

Classification as to the general nature of a load can be made usually. Constant horsepower, constant torque, and variable torque are the most common designations. For instance, a metal-working lathe can be termed a constant horsepower load, as a deeper

The Author

Graduate of the great open spaces of El Paso, Texas, Joe Benish began investigating mines at the Texas School of Mines there; two years later he fared eastward and in two more years received the bachelor of science degree in electrical engineering at Texas A & M College. Hardly content with this attainment he worked toward and received the master's degree from the same Alma Mater, 1949. During these intervening years he gathered much experience as test engineer for General Electric at Schenectady and elsewhere, as design and application engineer on Navy and other important work during the recent World War II, returning to Texas A & M as assistant professor, teaching a-c circuits and machinery, electrical measurements, etc., at College Station, where he is now affiliated. Member of AIEE and a Texas-registered electrical engineer, Benish likes to watch for "the absence" of hooks and slices on a tough golf course; softball, and to "play a mean trumpet," to round out the extraordinary versatility of an engineer-citizen.

Joe Benish

EXCLUSIVE

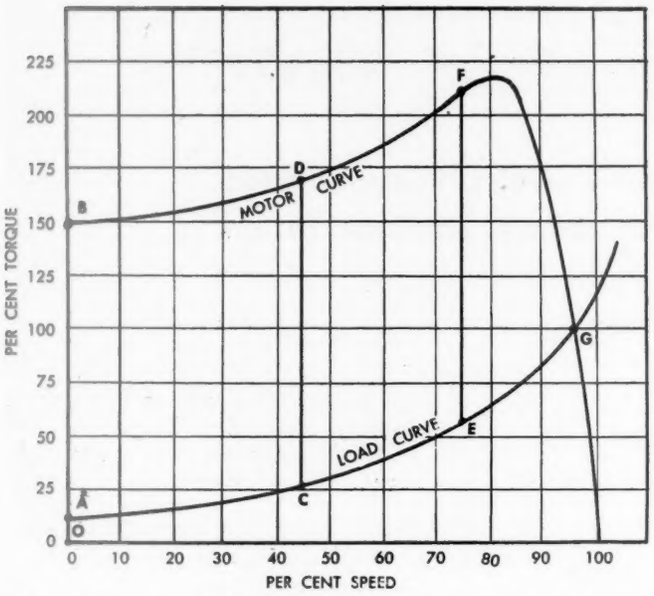


FIG. 1. Speed versus torque curves for load and motor. Load curve is typical for fans, blowers, and centrifugal pumps.

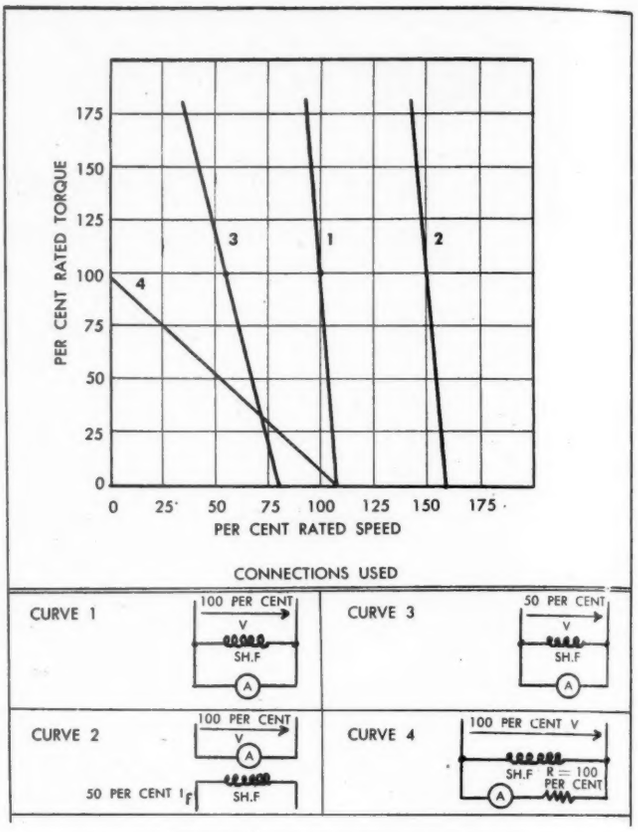


FIG. 2. Speed versus torque. D-c shunt motor.

Where:
V is rated line voltage
I_f is rated field current of shunt motor
A is armature of shunt motor
SH.F. is field of shunt motor
R is a resistance (100 per cent R means a value of resistance equal to line voltage divided by rated current of the motor.)

cut will be made as the speed is decreased. Thus the increase in torque makes up for the decrease in speed, the horsepower remaining relatively constant. On the other hand, reels for winding various materials usually require constant tension and hence constant torque regardless of the speed. And finally, a centrifugal pump would be termed a variable torque load, as the torque required increases as the speed increases.

The method of mounting should be taken into consideration when selecting a motor. Should the load require motor mounting in any position other than with the shaft horizontal, an increase in price will invariably result. Most manufacturers list a standard line of vertical shaft motors that include bearings suitable for this type of operation.

Another factor to be considered is the coupling to be used between the load and motor. Should the required speed permit direct connection, this is usually the most economical method. For small speed increases or reductions, belt drive is often satisfactory. If, however, freedom from maintenance troubles or compactness is important, gear drive should be considered. A tremendous variety and range of gear motors is available now. Standard gear motors with shaft speeds down to a few revolutions per minute are listed by several manufacturers. And finally, severe jolts to the load caused by the motor, which might be prohibitive for some applications, can be avoided by the use of fluid or magnetic clutch arrangements.

Many loads have an inherently high inertia. This must be overcome by the motor in order that acceleration to rated speed shall take place. The motor is subjected to severe overcurrents on starting such a load. Oftentimes this makes the selection of a larger motor necessary. Another choice in this case is to select a motor with extra starting torque in order that acceleration to rated speed takes place in a short enough time to forestall damage to the motor.

In the event that the inertia of a load is known, the approximate time required to accelerate from one speed to another is given by:

$$t = \frac{(\text{change in rpm})\ (I)}{308\ T} \text{ seconds}$$

Where:
$I =$ inertia in lb ft^2
$T =$ torque in ft lb

The average torque available for acceleration can be estimated by referring to the difference in torques for the load and motor at some intermediate speed. Then, if small increments of speed are used, and the times are added, the total time required for acceleration can be calculated.

Normally, values of inertia (WR^2) for any motor are furnished by the manufacturer. If the load rotates, the WR^2 can be calculated. Usually, however, the shape of the load will be such as to make the direct calculation extremely difficult. The WR^2 can be measured by suspending the rotating member from a long wire that is attached rigidly at both ends, forming a torsional pendulum. The axis of rotation of the wire and the member should correspond as nearly as possible. The time for a given number of torsional oscillations should be measured. This test should be repeated for a simple, homogeneous disk that has approximately the same weight. Then:

$$WR^2 \text{ of load} = (WR^2 \text{ of disk})\ (\text{time of load/time of disk})^2$$

If the load travels in straight-line motion, the WR^2 can be found from:

$$WR^2 = \frac{(\text{Weight})\ (\text{Speed in ft per min})}{(\text{mech. eff.})\ (2\pi)\ (\text{rpm of motor})}$$

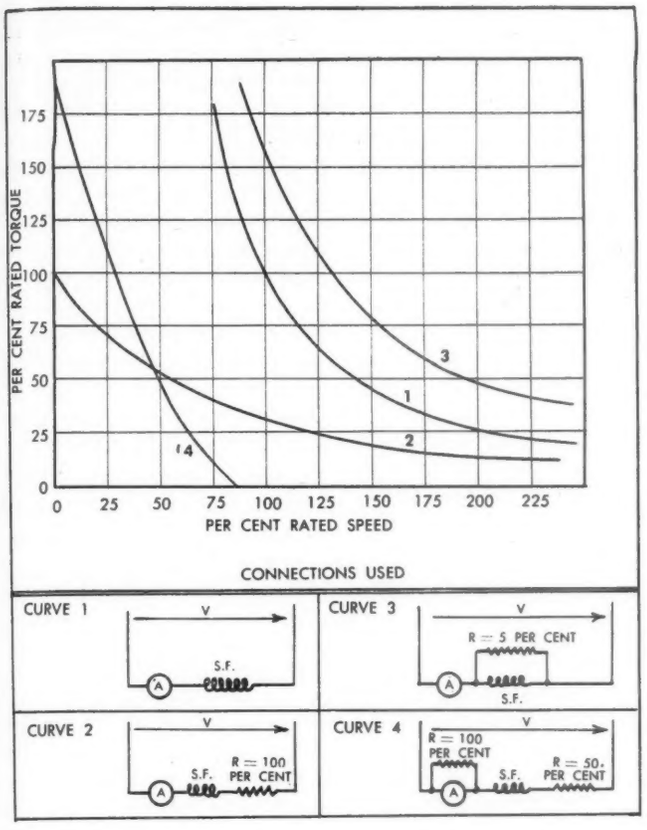


FIG. 3. Speed versus torque. D-c series motor.

Where:

V is constant line voltage
A is armature of series motor
S.F. is field of series motor
R is a resistance (100 per cent R means a value of resistance equal to line voltage divided by rated current of the motor.)

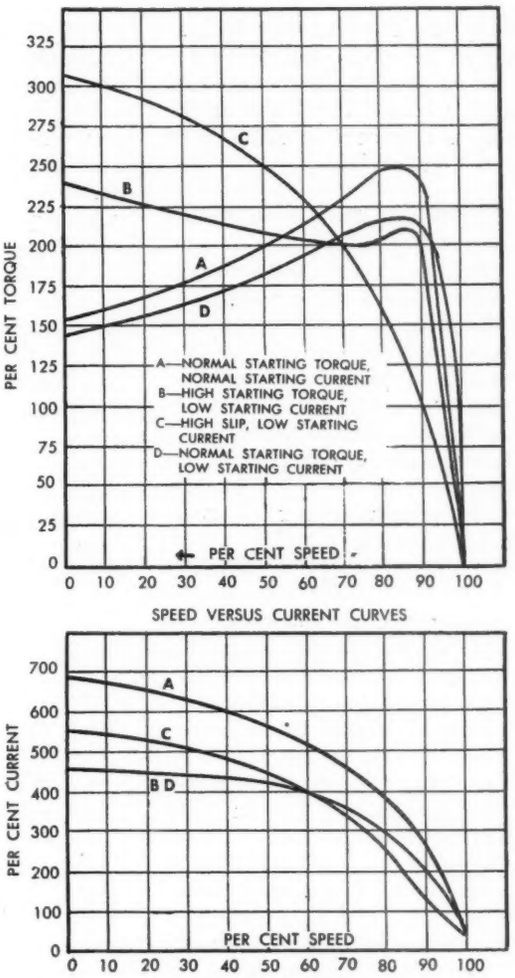


FIG. 4. Speed versus torque curves. Squirrel cage motors.

And, if the load rotates, but at a different speed from the motor: $WR^2 =$

$$\frac{(WR^2)\,(\text{rpm of load})^2}{(\text{mech. eff.})\,(\text{rpm of motor})^2}$$

at the motor shaft.

When the WR^2 of the load referred to the motor shaft is obtained, this can be used to estimate the time of acceleration of the system. This time, in conjunction with a current vs. speed curve of the motor, can be used to determine the approximate current requirements during acceleration. Should these currents turn out to be greater than allowed by the overload protection of the motor, special protection, or a larger motor is indicated.

Operating Characteristics of d-c Motors

Direct current motors can be divided into three classifications; shunt, series, and compound motors. Primarily, the difference between the shunt and series motor lies in the field winding. The shunt motor has a high-resistance field winding of many turns, usually connected in parallel with the armature. The series motor has a low-resistance field winding of a few turns, usually connected in series with the armature. The compound motor contains both a shunt and series field. The possibility of controlling the speed over a wide range is normally the determining factor in the selection of a d-c motor. This variation of speed is accomplished by varying the field current, the armature voltage, the armature current, or a combination of these quantities.

The shunt motor affords the best chance of any motor to vary speed smoothly over a wide range without an undue loss of efficiency. Fig. 2 shows typical speed-torque curves for a shunt motor for given settings of the possible variables. These curves show that, once a speed setting is made, the motor speed decreases only slightly as load torque is increased, particularly when full voltage is applied to the armature (curves 1 and 2.) Reduction of armature voltage (curve 3) or addition of resistance in series with the armature (curve 4) causes a greater variation in speed for a change in torque.

The series motor is ideal where extremely large values of starting torque are required; where change of speed with varying torque does not impair performance of the load; where extreme flexibility of control over operating characteristics of the motor is required; or where it is desired to handle heavy loads at low speed and light loads at high speed. By proper use of resistors to shunt portions of the current from the field, or by combining this scheme with shunt resistors across the armature, or resistors in series with the armature, an extremely great variety of speed-torque characteristics can be obtained. As a brief illustration of the possibilities, Fig. 3 shows typical characteristics that can be obtained from a d-c series motor. Reference to this figure shows that, although the motor exhibits a tendency to "run away" at low values of torque, this effect can be eliminated by proper use of resistance across the armature. Use of this resistance, of course, seriously lowers the operating efficiency of the motor.

Virtually any combination of characteristics of the shunt and series d-c motor can be obtained by the use of a compound motor. This is accomplished by proper control of the current in each of the fields.

Operating Characteristics of a-c Motors

The most universally-used motor for carrying loads from a few up to several hundred horsepower is the three-phase, squirrel cage induction motor. In this range, it is the least expensive, and for a wide variety of applications has the most desirable operation of any motor available. Typical speed-torque curves for a number of different varieties of this basic type of motor are shown in Fig. 4.

Synchronous Motors

In the event that an installation is to be made that requires the use of 50 hp or more at very slow speeds; or over 500 hp at almost any speed; the possibility of using a synchronous motor should be investigated. Very often the purchase price is less than that of an induction motor in this range. And, as it is possible to control the power factor of a synchronous motor, large savings in operating costs are often possible. The high efficiency of a synchronous motor over most of its load range also effects savings.

The wound rotor induction motor is similar to the squirrel cage induction motor with the exception of the rotor. A winding that has provisions for inserting external resistance is built into the rotor. Insertion of this external resistance makes the variation of speed possible. This cuts down materially on the efficiency, however. Typical curves for a wound rotor induction motor are illustrated in Fig. 5.

Single-phase motors are perhaps the most versatile motors in existence. The fact that their applications are limited to those requiring at the most a few horsepower is the only limitation imposed upon their selection. A complete breakdown of the number of operating principles used in these motors would be next to impossible. As they find use in industrial plants, however, the following breakdown would include a large percentage:

1. Motors with squirrel cage rotors:
   (a) Split-phase start—least expensive as well as the type that conforms most closely to 3-phase induction motor.
   (b) Capacitor—utilize a capacitor to provide large starting torques. The capacitor is also used in many motors to provide higher power factor.
2. Motors with wound rotors and commutators:
   (a) Repulsion—used as variable speed motors. Speed-torque curves resemble those of a 3-phase, high resistance squirrel cage motor. Variation of speed is possible by brush shift or change of applied voltage.
   (b) Series or universal type—comparable to a series d-c motor. Designed to have similar characteristics on a-c or d-c.
   (c) Repulsion-induction type—furnish almost constant speed over a wide range of torques.

Speed-torque curves for a number of single-phase motors are shown in Fig. 6.

Determination of Horsepower Rating

Perhaps one of the greatest mistakes made in the selection of motors is the choice of a motor of too *great* a horsepower rating. The corresponding loss of efficiency, the greater currents re-

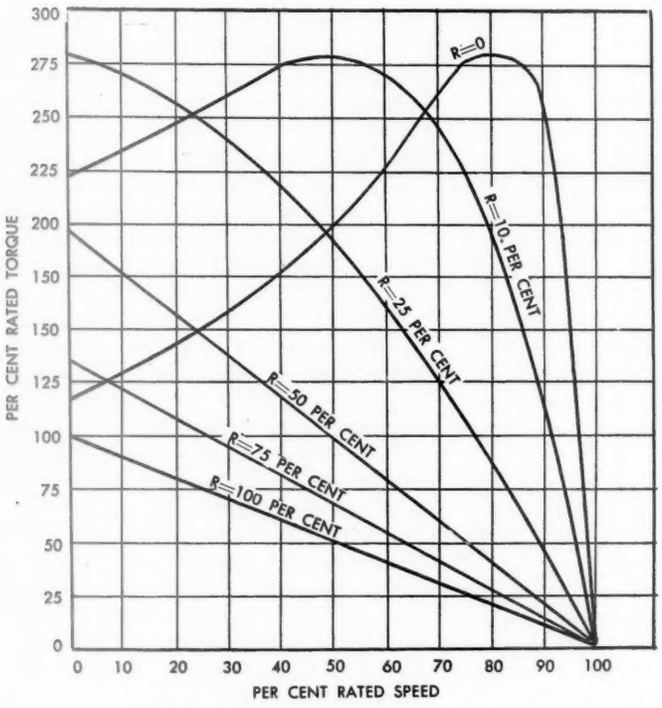


FIG. 5. Speed versus torque curves. Wound rotor induction motor.

Notes:
100 per cent R is that external resistance, added to the rotor circuit, which causes full load torque on starting.
For a given torque, speed is decreased by addition of external resistance.

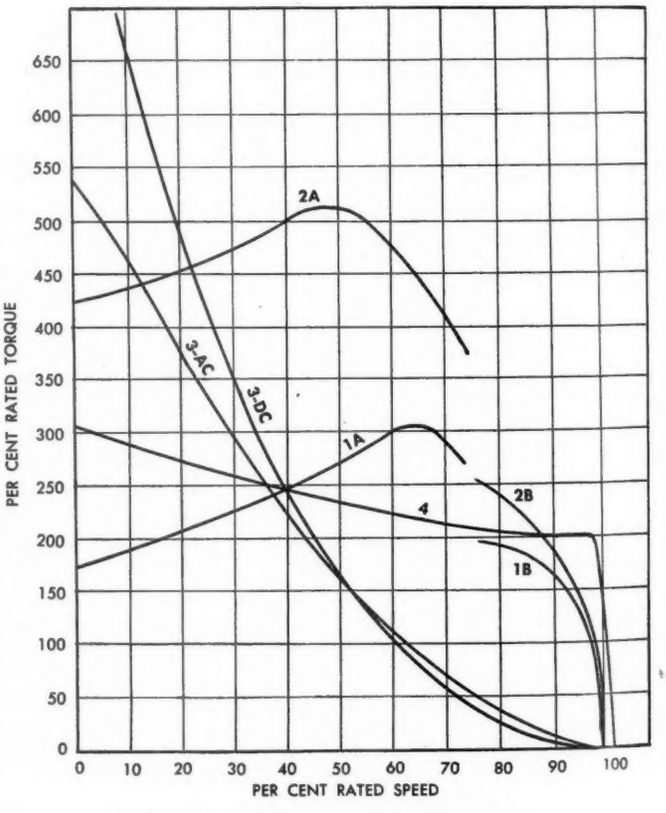


FIG. 6. Speed versus torque curves. Single phase a-c motors.

A—Starting B—Running
1—Split phase motor
2—Capacitor start motor
3—Universal motor
4—Repulsion-induction motor

quired, and the additional price make the few minutes necessary to determine the correct horsepower rating well worth while. If the horsepower rating is calculated properly, considering such things as inertia of the load and intermittent duty required of the motor (discussed below), the safety factors built into the motors by the manufacturer will allow for other slight variations.

Table 1 lists a number of formulas for the calculation of horsepower for various types of service. In the event that reduction gears or complex coupling systems are used, results of these calculations should be multiplied by (100/ per cent efficiency of the gear or coupling.)

If the horsepower requirements of the load vary considerably within a period of an hour or less, the root-mean-square method of calculation may be used. This method is based upon the principal that the heating of a motor is a function of both time and load on the motor. By this method, the motor horsepower can be found from:

$$HP = \sqrt{\frac{(HP_1)^2(t_1) + (HP_2)^2(t_2) + (HP_3)^2(t_3) + \cdots}{t_1 + t_2 + t_3 + \cdots}}$$

where HP_1 is the horsepower required during time interval t_1, etc. Note that if the motor runs idle for a given length of time, this time should still be included in the denominator, which results in lowering the required motor horsepower. In case the motor is stopped during the idle period, use only 1/3 of the time while the motor is stopped as the cooling effect is greatly reduced.

In cases where the horsepower variation is extreme throughout the duty cycle, the possibility of using a specially-designed, intermittent-rated motor should be investigated.

Economic Factors to Be Considered

The most tangible cost of a motor, as well as the first cost to be encountered, is the purchase price. In order to illustrate the relative prices of various features available in motors, as well as the relative prices of the different types of motors, Table 2 has been prepared. This table uses the price of a 3-phase, 4 hp, 1800 rpm, general purpose, squirrel cage induction motor as a base, i.e., 100 per cent cost per horsepower. All other prices are first divided by the horsepower rating of the motor, then taken as a percentage of the base motor price. For any particular manufacturer, the relative prices will vary somewhat. The table, however, should serve as an indication of the approximate relation any given motor price will have to other motor prices for any manufacturer.

A number of conclusions can be reached through a study of Table 2. Regardless of motor type, its price per horsepower will decrease with increase in motor rating. This suggests the possibility of using one large motor to do the work of several smaller ones wherever the application permits. Special enclosures increase the price of a motor greatly. Thus a saving could be made if the motor could be situated in a position remote from explosive gases. It should also be noted that the price per horsepower increases as the speed goes down. This is simply due to the fact that the size of a motor increases as the speed decreases for a given horsepower rating. For instance, a 5 hp, 1800 rpm motor will be smaller than a 5 hp, 900 rpm motor, and about the same size as a 7½ hp, 3600 rpm motor, or a 3 hp, 1200 rpm motor.

The most important factor in operating costs is the efficiency. Motor manufacturers will guarantee various values of efficiency, dependent upon the type and expected service of the motor. In general, the large synchronous motor can be expected to have the highest efficiency of any motor type. The 3-phase, squirrel cage induction motor will usually come next, followed by the d-c shunt motor. The efficiencies of the wound rotor induction motor and the d-c series motor are largely dependent upon the means used to control the speed. For the special condition in which no speed control is

TABLE 1

Horsepower formulas.

1. Rotational:

$$HP = \frac{(2)\,(\text{Torque in ft lb})\,(\text{rpm})}{33{,}000}$$

2. Linear:

$$HP = \frac{(\text{Force in lb})\,(\text{Velocity in ft per sec})}{550}$$

3. Blowing air:

$$HP = \frac{(\text{Vol. in ft}^3/\text{min})\,(\text{head—in. of water})}{6340}$$

4. Pumping water:

$$HP = \frac{(8.34)\,(\text{gal per min})\,(\text{head in ft})}{33{,}000}$$

5. Compressing cases:

$$HP = \frac{p_m LAN}{33{,}000}$$

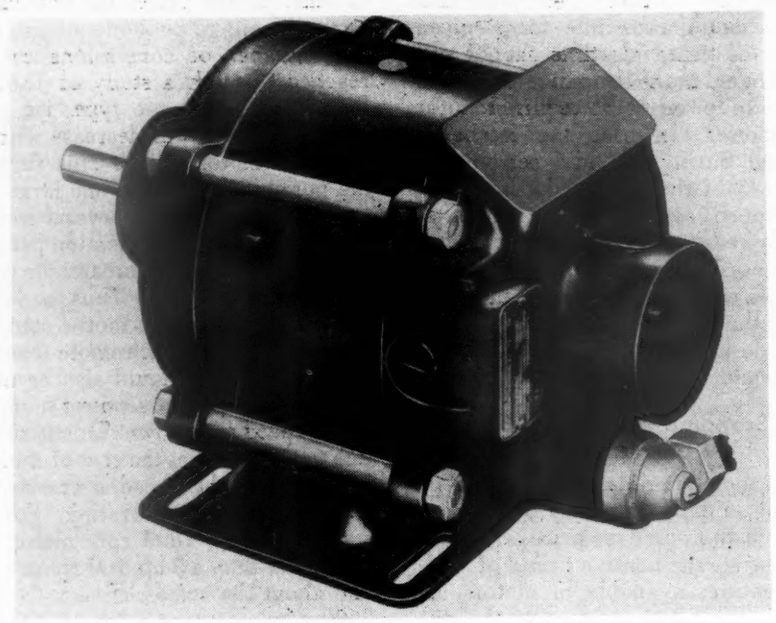
Where:
p_m is mean eff. press. in lb./in.²
L is length of stroke in ft
A is area of piston in sq in.
N is no. of power cycles per min

TABLE 2

Relative prices of various motors.

Motor type	HP	Base speed rpm	Enclosure	Relative price per hp
A	5	3600	Open	92%
A	5	1800	Open	100%
A	5	1200	Open	131%
A	5	900	Open	175%
A	5	720	Open	219%
A	5	600	Open	292%
B	5	1800	Open	105%
C	5	1800	Open	210%
D	5	1800	Open	245%
A	5	1800	Class I Gr. D	172%
B	5	1800	Class I Gr. D	176%
C	5	1800	Class I Gr. D	352%
D	5	1800	Class I Gr. D	400%
F	¼	1800	Open	346%
G	¼	1800	Open	422%
F	¼	1800	Class I Gr. D	670%
G	¼	1800	Class I Gr. D	1120%
A	50	1800	Open	51%
B	50	1800	Open	54%
C	50	1800	Oepn	71%
D	50	1800	Open	90%
E	50	1800	Open	151%
A	50	1800	Class I Gr. D	96%
B	50	1800	Class I Gr. D	99%
C	50	1800	Class I Gr. D	164%
D	50	1800	Class I Gr. D	187%
E	200	1800	Open	62%

Key to motor types:
A—Squirrel cage, general purpose, 3 phase
B—Squirrel cage, high starting torque, 3 phase
C—Direct current
D—Wound rotor induction
E—Synchronous
F—Single phase, split phase
G—Single phase, capacitor start



GE-type B-C motor.

used (zero external resistance in rotor of wound rotor motor; no resistance of any kind in a series motor) the wound rotor motor will probably come next in line, followed by the d-c series motor, and finally by the single-phase motor. Variation of the speed of single-phase motors by brush shifting, however, does not decrease the efficiency to nearly the extent that it is decreased in the case of the wound rotor or series motor.

Maintenance costs are to a large extent intangible. From the standpoint of probability, the more complex the construction of a motor, the greater are the chances of its requiring maintenance attention. From this standpoint, the 3-phase, squirrel-cage induction motor is superior to all other types. Any motor that has a commutator will require attention from time to time. The condition of the commutator, as well as that of the brushes, will require checking and occasional work. And, particularly in the case of large d-c motors, overloading the machine is likely to result in damage to the commutator, which is an expensive matter to correct. An insulated winding on the rotor of any motor also makes trouble more probable. The most likely damage resulting from prolonged overloads is damage to the insulation. In addition, corrosive atmospheres, damp conditions, or the lack of proper ventilation will decrease the life of the insulation. Thus some of the recently-developed insulations such as the various silicone products may easily pay for themselves in prolonged insulation life.

Special bearings have been developed to increase trouble-free motor life. Particularly in the smaller horsepower ratings, bearings that require no attention for extremely long periods of time (often measured in years) are available. The use of these bearings on motors in inaccessible locations often pays for the additional cost of these bearings in a fraction of the lifetime of the motor.

Codes and Standards

Compliance with various standards is a necessity in order to qualify for reasonable insurance rates. In addition, many specifications must be observed to conform to the law. In selecting motors, any unusual condition should be checked against the following:

1. National Electric Code—guides inspectors when approving motor installations.
2. State laws—set up safety requirements.
3. City ordinances—vary widely but often specify special construction and installation.
4. National Electrical Manufacturer's Association—sets up minimum performance standards. Can be used as a comparison against the previous to determine whether or not motors purchased from member companies will meet the necessary requirements.

Enclosures

The basic enclosure for equipment to be used in the absence of unusual gas or moisture conditions is the open type enclosure. It is invariably the most economical and should be used except in special cases. In processing plants, however, special conditions are often the rule. The National Electric Code classifies a motor, constructed so as to permit explosions within the motor without ignition of the surrounding atmosphere, as an explosion-proof motor. The sub-classification usually applicable to petroleum processing plants is Class I, Group D. It is specified for use in "atmospheres containing gasoline, petroleum, naphtha, alcohol, acetone, lacquer solvent vapor, and natural gas." The construction is such that the enclosure is strong enough to withstand the maximum pressure that might be caused by an explosion. In addition, long fits with close clearances at all joints and shafts are provided to cool escaping gases before they come in contact with the surrounding atmosphere. Such motors, utilizing fan-cooled construction, are available up to approximately 500 hp ratings. Above this rating a base-ventilated, or inert - gas - filled motor may be specified. * * *

Mexican Refinery Placed in Operation

The new 30,000-bbl-per-day Petroleos Mexicanos refinery at Salamanca, Guanajuato, (150 miles northwest of Mexico, D. F.) began full operations in September. Desulfurization of the straight run gasoline production will be performed in the 11,600-bbl-per-day Perco Cycloversion unit. Engineering and construction were handled by Arthur G. McKee and Company, Cleveland, Ohio.

Programs to modernize and expand the facilities of the Petroleos Mexicanos refineries at Tampico, Tamaulipas, and Atzcapotzalco, D. F. are also underway. These refineries will incorporate 12,000-bbl-per-day Perco Cycloversion units.

The Technical Forum

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Specific Heat Ratio in Compression Calculations

Referring further to the question and answer presented in the July, 1950 Refining & Gas Processing Edition, Technical Forum, Page C-46, under the heading, "Specific Heat Ratio Constant", an article by W. C. Edmister was referred to, discussing the method for determining "K" values in making gas compression calculations. Here Dr. Edmister discusses this phase of the problem in greater detail, expanding the explanation given by Profs. Farrar and Platt for the calculation of this term and its application in the gas industry.

The original question is: Q. How may the value of "K" (the ratio of specific heats, $\frac{C_p}{C_v}$), for natural gas be computed, assuming that the per cent by volume of each of the components of the mixture is known? Is "K" of the mixture a weighted average of the values of "K" for each of the component gases?—J. F. Todd.

A The specific heat ratio ($k = C_p/C_v$) of a gas is widely used in making gas compression calculations. This ratio is not always used correctly and the situation was not bettered, when, in 1940, the writer published a chart for evaluating C_p/C_v values for hydrocarbons at different pressures and temperatures in *Ind. Eng. Chem. 32*, 373.

The specific heat ratios given on this chart were correct but it does not follow that these values should be used in the following compression formulae

$$T_2 = T_1\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} \quad . \quad . \quad . \quad . \quad (1)$$

$$-W_s = P_1V_1\frac{n}{n-1}\left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right] \quad . \quad . \quad . \quad . \quad (2)$$

Equations 1 and 2 are rigorous for the reversible adiabatic compression of perfect gases. For this case the value of the exponent n is the specific heat ratio $k = C_p/C_v$.

Equation 2 is rigorous for any gas where the path followed is defined by PV^n = constant and the compression is reversible, but not necessarily adiabatic.

From the above it can be seen that the exponents in equations 1 and 2 are not necessarily the same, except for a perfect gas.

The exponent in equation 1 for real gases was recently developed (Edmister and McGarry, *Chem. Eng. Prog. 45*, 421 (1949)) in terms of generalized thermodynamic functions and the ideal gas state (zero pressure) heat capacity. In this proposed method of finding the isentropic temperature change, equation 1 becomes

$$T_2 = T_1\left(\frac{P_2}{P_1}\right)^{\frac{R\left[Z + T_r\left(\frac{\partial Z}{\partial T_r}\right)_{P_r}\right]}{C_p^\circ + \Delta C_p}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Values of the terms in the exponent of equation 3 are given on Figs. 1, 2 and 3. The procedure of applying these charts is illustrated in the article by Edmister and McGarry.

The work of reversible isentropic compression may be computed by finding the value of ΔH in the manner proposed by Edmister and McGarry. It may also be found by applying equation 2 with the proper exponent, which has not yet been satisfactorily established.

One thing can be said about the exponent in equation 2, however, and that is that it is not the ratio of specific heats at the operating conditions. Including the effect of pressure in computing C_p/C_v gives values of the exponent that are too high. It is suggested that the value of n be found from Fig. 1 and the following relationship

$$n = \frac{C_p^\circ}{C_v^\circ} = \frac{C_p^\circ}{C_p^\circ - R} \quad . \quad . \quad 4$$

This appears to give the best results of anything yet tried by this writer.

Wayne C. Edmister

(Figures follow)

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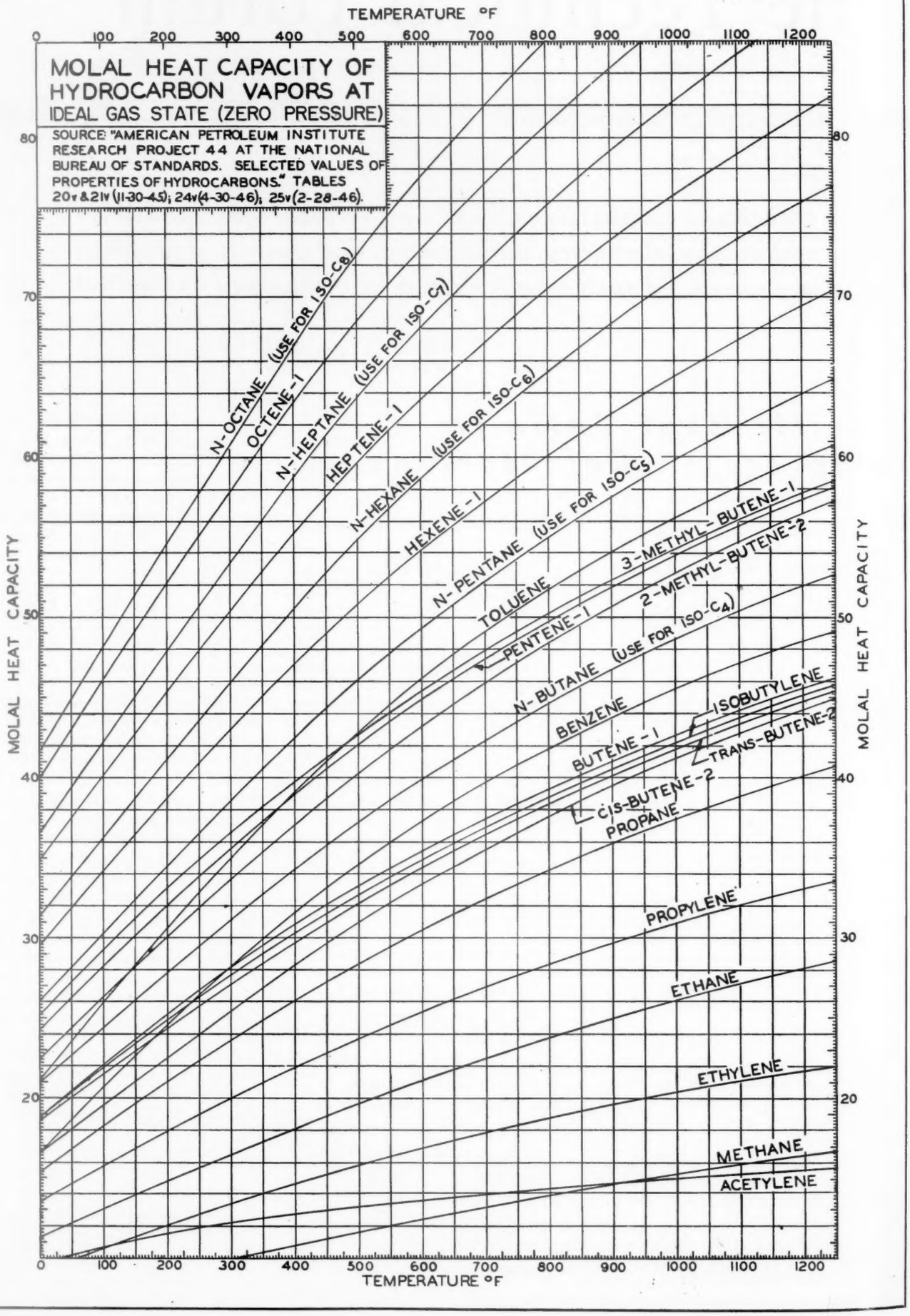
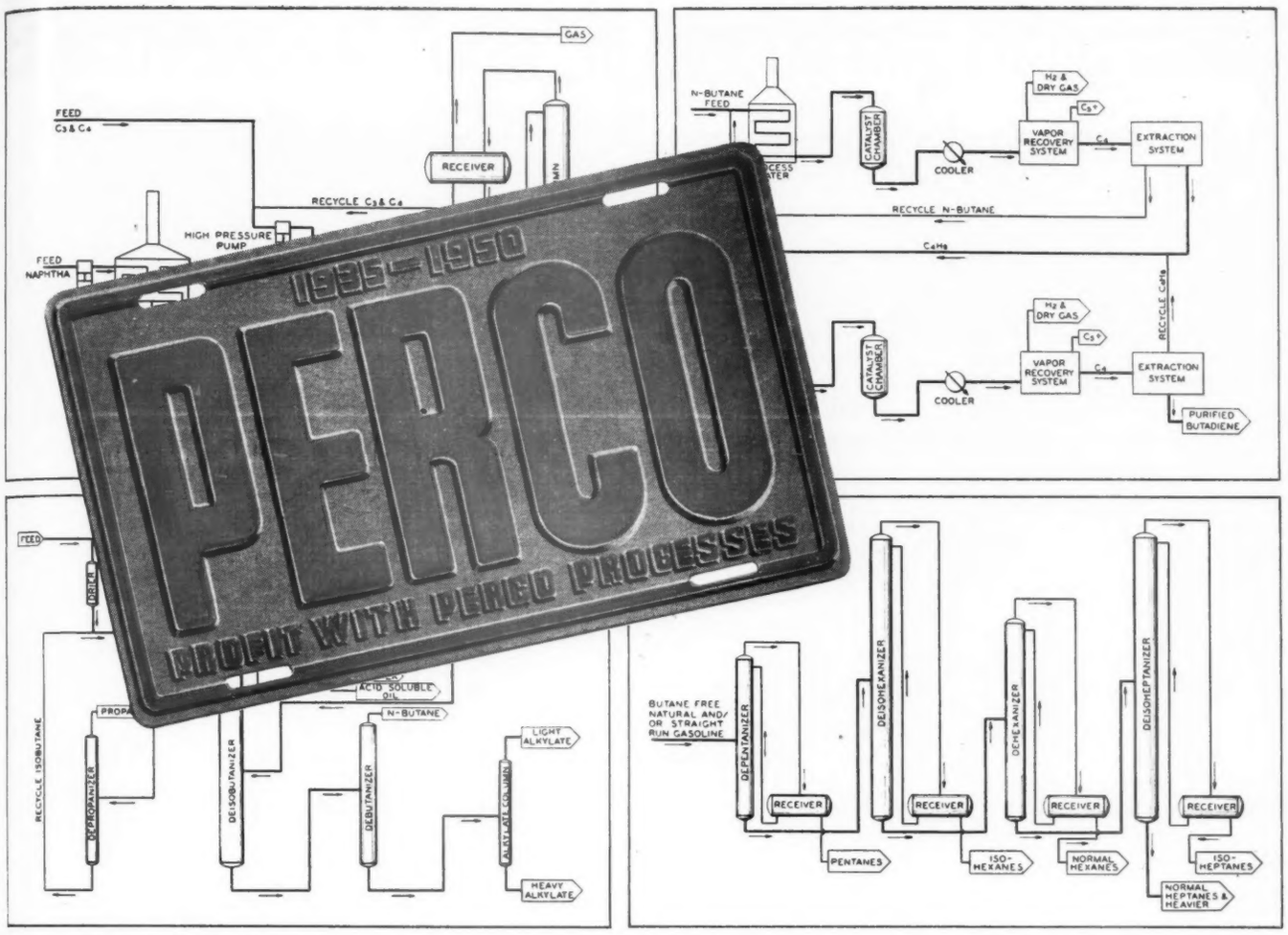
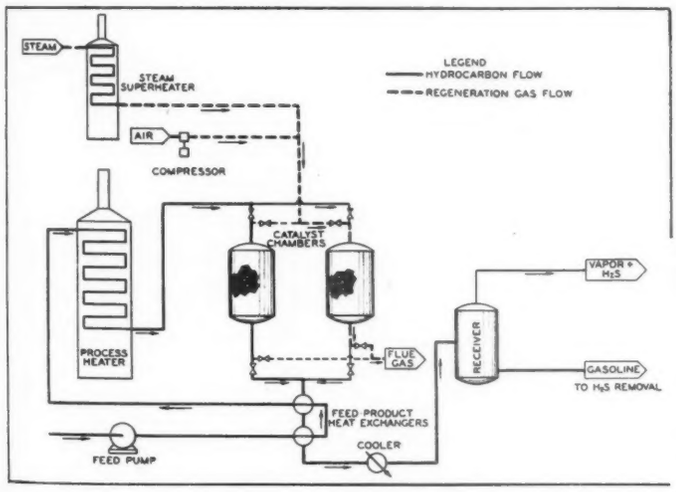
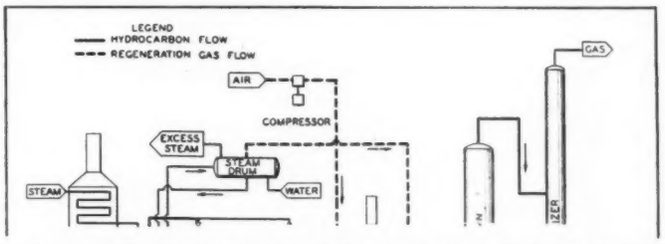
FIG. 1. VALUES OF Cp°

Source: W. C. Edmist









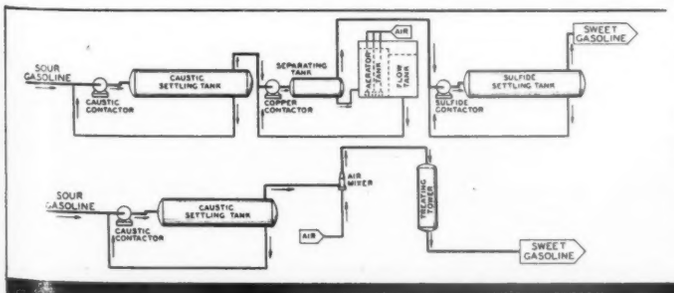


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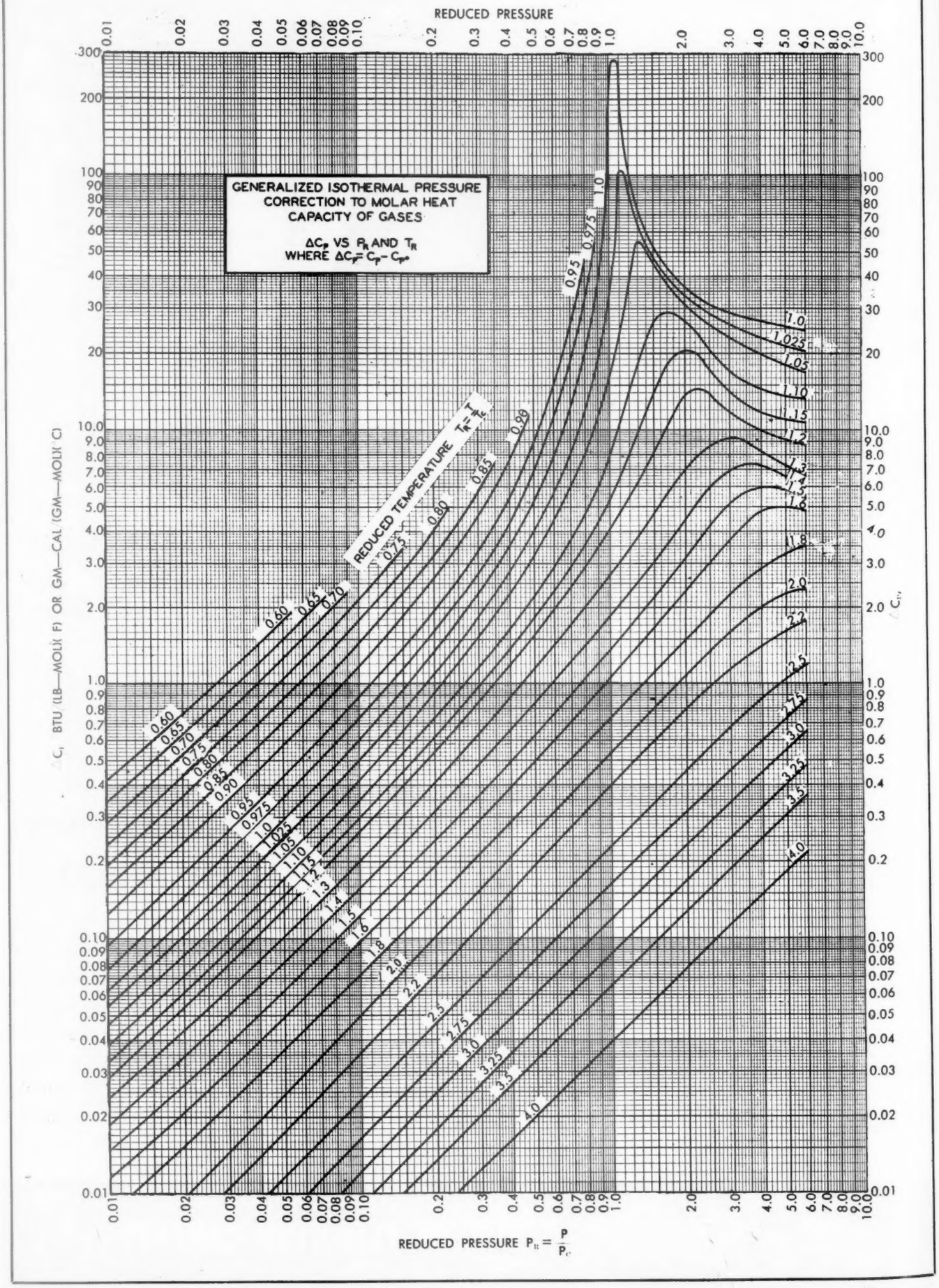
FIG. 2. Isothermal pressure correction to heat capacity.

Source: W. C. Edmister


GENERALIZED ISOTHERMAL PRESSURE CORRECTION TO MOLAR HEAT CAPACITY OF GASES
ΔCp VS PR AND TR
WHERE ΔCp = Cp - Cp°
REDUCED PRESSURE
REDUCED TEMPERATURE TR = T/Tc
REDUCED PRESSURE PR = P/Pc
ΔCp, BTU (LB—MOL)(° F) OR GM—CAL (GM—MOL)(° C)

Effectiveness of "Lead" in Suppressing Autoignition Assumes New Importance to Refiners

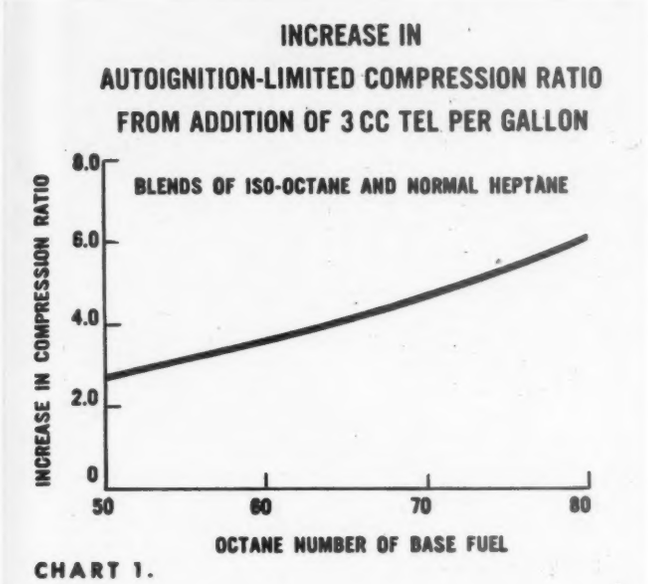


CHART 1.

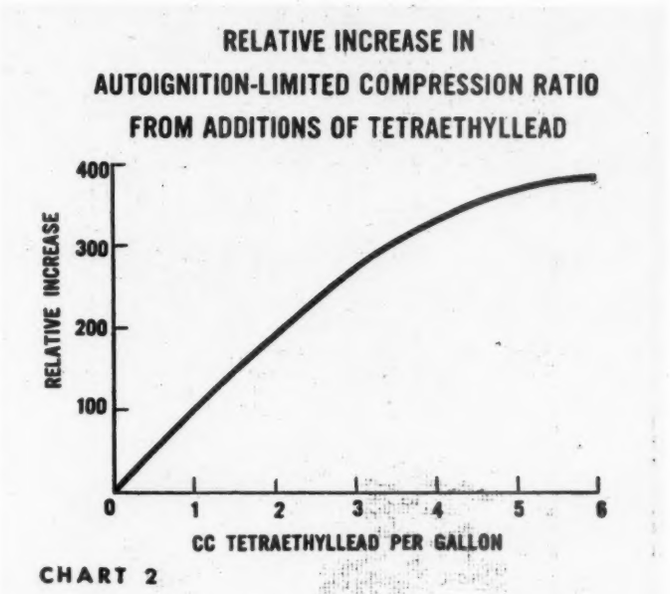


CHART 2

Tetraethyllead's effectiveness for reducing the tendency of fuels to autoignite was demonstrated by Ethyl as early as 1935. Since that time, this original knowledge has been expanded by a continuing research program.

The most significant fact disclosed by Ethyl's research is that the effectiveness of tetraethyllead in controlling autoignition increases both as the antiknock quality of the base gasoline is improved and as the concentration of lead is increased.

An engine was driven at 900 rpm with greatly retarded ignition. The compression ratio was slowly increased until firing was initiated by autoignition of the fuel. The compression ratio was then reduced slightly until firing ceased. This value was considered to be the limiting compression ratio imposed by autoignition.

On this basis, when the base fuel was a 50-50 blend of iso-octane with normal heptane, the addition of 3 cc of tetraethyllead per gallon of fuel enabled the engine to operate without autoignition at 2.6 ratios higher compression. When the base fuel was an 80-20 blend of iso-octane with normal heptane, 3 cc of tetraethyllead permitted an increase of 6.1 ratios (Chart 1).

The high effectiveness of the second and third cc of tetraethyllead in the suppression of autoignition is shown in Chart 2. Two cc are almost twice as effective as one cc; three cc are 2.7 times as effective as one. Additions of tetraethyllead beyond 3 cc per gallon also have a high effectiveness.

The data show that tetraethyllead offers the refiner—and the eventual user of his gasoline—a double value. It is effective in suppressing autoignition as well as knock. Both of these contributions will increase in importance in the future.

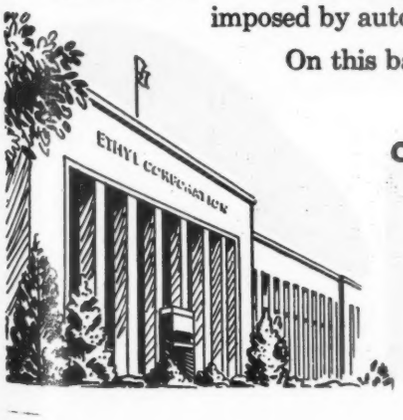


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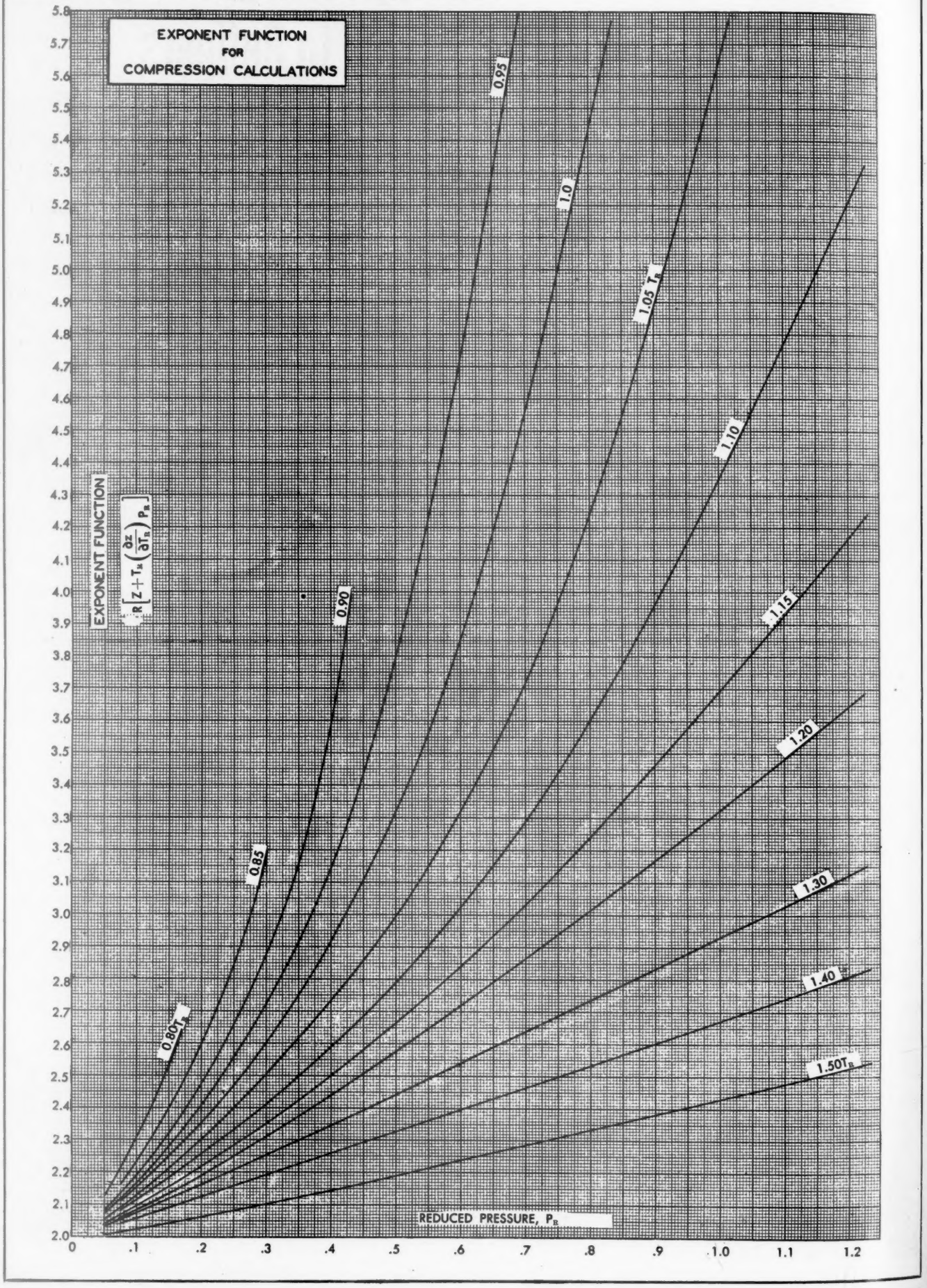
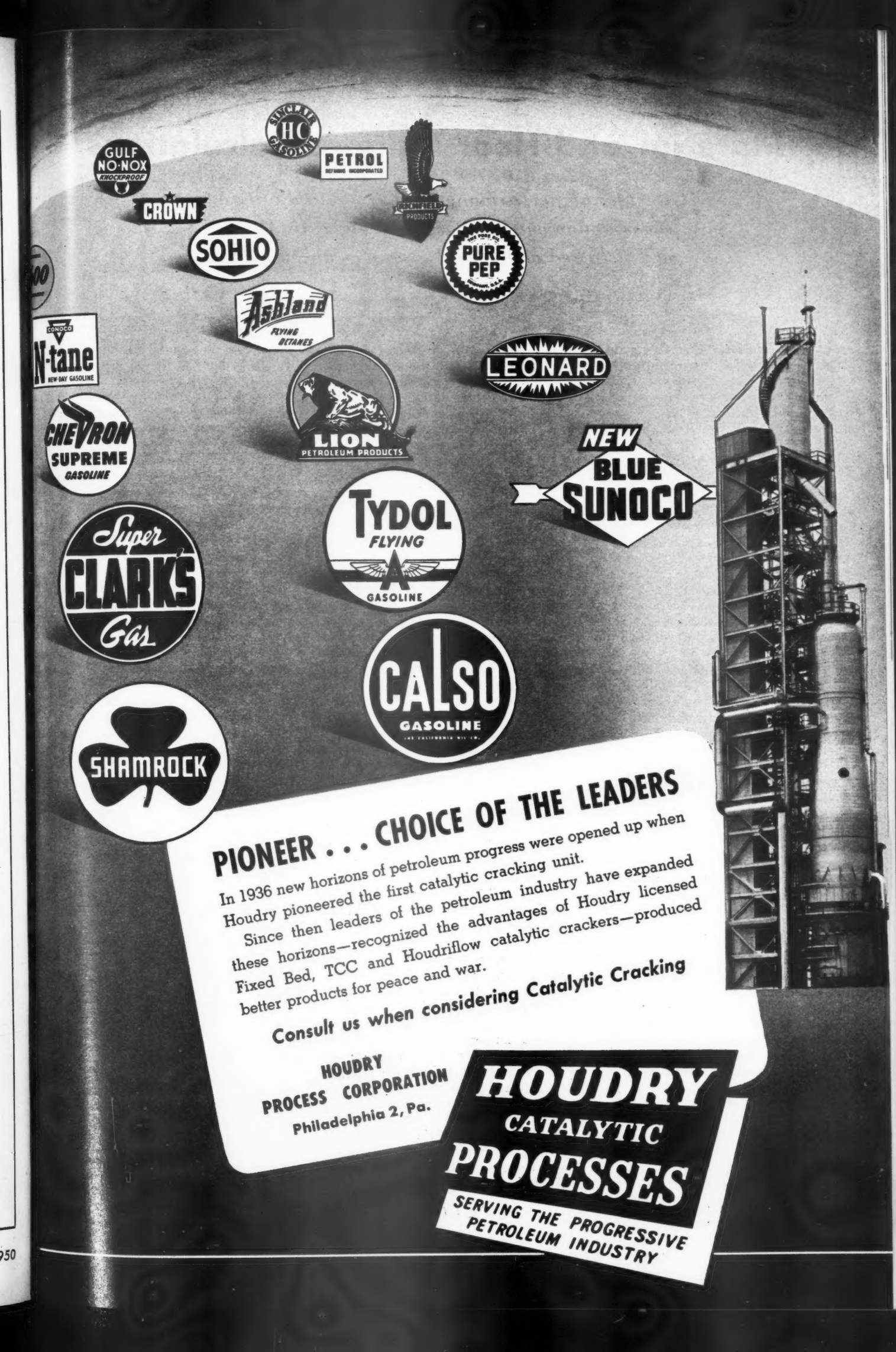
FIG. 3. Exponent for isentropic temperature change calculations.

Source: W. C. Edmister and R. J. McGar

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Material and Heat Balance Calculations

Results of performance tests in a study of fuel consumption and combustion in boilers, stills, etc., are discussed and typical examples are described.

G. L. FARRAR*

USUALLY the most important point to be considered in the operation of a unit or process to produce a given amount of product is the establishment and maintenance of unit cost of product at its lowest level. Some organizations provide for checking the operational characteristics of a given process on a daily basis, while others make these checks less frequently. At any rate, a periodic critical examination of process operations must be made if maximum economy is to be effected. Such examinations are commonly called performance tests. It is the purpose of this article to indicate the importance of making proper material and heat balances if significant results are to be obtained from the performance tests.

The first result obtained from making a complete material and heat balance on a process is an evaluation of the actual loss of heat and material in the process. An examination of ways and means of reducing or eliminating these losses is then made. The extent of the corrections will depend entirely on the economics of the indicated changes. For example, it is impossible to completely eliminate heat loss from a process, as long as the process temperature is higher than the ambient temperature. Insulation is applied until the cost of additional heat loss is equal to the amortized cost of the insulation. Application of additional insulation would be economically unfeasible, as the insulation would cost more than the additional saving due to reduction in heat loss.

Loss of material in a process may be due to leaking relief valves, pump leakage, improper seating of shut-off valves, and other similar causes. The material balance should be made on a weight basis, rather than a volumetric basis, as changes in density result frequently in the various processing steps encountered in petroleum refining and natural gasoline work. If an appreciable discrepancy exists in the overall material balance, every possible source of loss (or gain) should be thoroughly checked. Appreciable loss of material for even short periods of time results in quite substantial decreases in product recovery, and, hence, in appreciable decline in salable products.

A second result obtained from the material and heat balance calculations is the check on actual operating conditions. This point is especially important in the evaluation of a new unit or process. In this case the operating conditions should be maintained as close to those used in design of the process as possible. By following this procedure it is possible to check the design basis and provide more accurate information for the design of similar units. It is also possible to obtain information on the effects of the process variables (such as temperature, pressure, residence time, ratio of feed streams, etc.) on product quality and product recovery rates. This information will be available only in narrow ranges, and as the result of inherent variations in the system. If complete information concerning the optimum levels of the process variables is desired, a pilot plant investigation is necessary. At any rate, after accumulation of sufficient operating data, it is oftentimes possible to adjust the operating conditions to more favorable levels, and hence to effect additional economy in carrying out the operation.

Quite often the results from heat and material balance calculations can be used to determine the need for adjusting instruments, cleaning out heat exchanger tubes and flow meters, and making numerous other repairs and adjustments. For example, the amount of heat transferred in the reboiler of a fractionating column is readily calculated once the heat and material balance is completed. If either of the tube-side or shell-side fluid is scaling in nature, the amount of heat transferred will decrease with time on stream. When the heat transfer drops to a certain point, it is not possible to operate the column at its full capacity and a shutdown is necessary. The time schedule of operating and shutdown periods may then be adjusted to best advantage, based on the heat balance calculations.

In order to make complete material and heat balance calculations, certain physical data are necessary. The procurement of accurate physical data is a primary necessity if maximum gain is to be realized from the calculations. The information required will depend of course on the type of process being investigated. There are several physical characteristics that usually are required, however. Densities of all liquid streams are necessary to complete the material balance. When dealing with similar liquids, such as the various hydrocarbons, the law of additive volumes is usually assumed, and density data are obtained for each component in the streams. In petroleum work, liquid densities are usually given at 60 F, and correction must be applied, based on the actual existing temperature. Some tabulations show the actual density variation, while others record volumetric expansions coefficients (ratios of densities at other temperatures to that of 60 F).

Gas flows are ordinarily given at 60 F, and atmospheric pressure. Then, corrections must be made from the actual conditions to the base conditions. The perfect gas law, with correction for non-ideality, is used to make this change. The correction is usually made using the generalized reduced coordinating system, in which the correction factor, Z, is plotted as a function of reduced temperature and reduced pressure. If there are two or more components in the gas, the pseudo-reduced temperature and pressure must be obtained. This is done by obtaining mol average critical temperature and pressure. Then, $T_R = T_a/T_c'$, and $P_R = P_a/P_c'$. T_R and P_R are the reduced temperature and pressure, respectively, while T_c' and P_c' are the pseudo-critical properties, in absolute units. T_a and P_a are

*Assistant Professor of Chemical Engineering, Texas A. & M. College.

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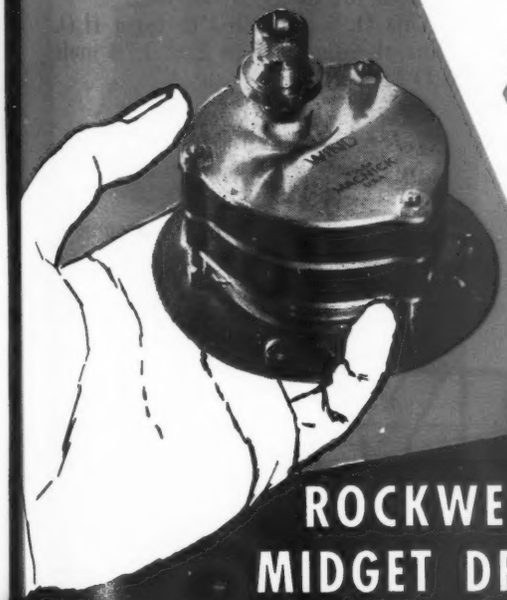

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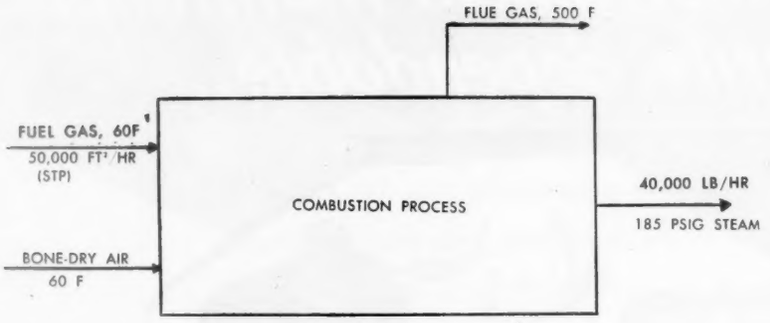

FIG. 1. Performance calculation.

the actual properties, also in absolute units.

In making the heat balance, certain thermal properties of each of the components present are required. The most convenient method for determining a heat balance is by use of total enthalpy charts. For ordinary processes, in which gas expansion or compression effects are negligible, these charts may be used even where there is some variation in pressure. It should be pointed out, however, that the change in enthalpy is exactly equal to the heat gained or released, only at constant pressure. Unfortunately, only a very few correlations of total enthalpy are currently available, and even these are of questionable accuracy, at least in certain ranges of temperature and pressure.

Lacking enthalpy data, either tabulations of specific heats must be available, or the specific heat of each component must be known as a function of temperature. Some correlations give mean specific heats between two given temperatures (usually between 60 F, and the desired temperatures), and these values are more convenient to use. It should be pointed out that some correction of specific heat for changing temperature is mandatory, especially at the higher temperature levels. If phase changes occur in the process, values of latent heats must be known at least at one temperature and pressure, for each component present. Knowing one value, it is possible to calculate values of latent heat at other conditions, provided specific heat data are known.

If more detailed calculations, such as pressure drop, rate of heat transfer, etc., are made, such data as viscosities, and thermal conductivities must be known. Heat transfer coefficients must either be known or calculated. Discussion of these items is beyond the scope of this paper, however.

These various physical properties are tabulated in a number of places, though the treatment is by no means exhaustive as yet. Some suggested sources of this information are (1) *The Petroleum Engineer's Continuous Tables,* (2) National Bureau of Standards, Technical Data, (3) Proceedings of the Natural Gasoline Association of America, (4) Technical Manual of NGAA Supply Men's Association, (5) Proceedings of the California Natural Gasoline Association, (6) *Chemical Engineers' Handbook,* 3rd Ed., (7) International Critical Tables, and (8) the various petroleum publications and scientific journals. Tabulations are more complete and convenient for use in the first six references.

Quite often when making a material balance on a process it is found that streams change in amount and composition from influent to effluent. When this situation occurs, the percentage composition of each stream is on a different basis from any of the other streams. The problem of finding a common basis for calculation is best solved by remembering that (1) at steady state, the total amount entering the process must be equal to the total amount leaving, and (2) the total amount of each component entering the process must be equal to the total amount of that same component leaving the process. Application of these two principles will enable the solution of any material balance problem, although the actual calculation may not be as simple as would first appear. These same principles also apply to heat balance, in that the heat entering a system must either be completely removed, or all or part of it will be used to increase the heat content of the system.

In a large number of cases, some inert component passes through the process and exits unchanged. Calculations may then be based on this component and its relative distribution in the various feed and product streams. An example of the use of this principle is found in the usual combustion calculation, in which the performance of a boiler or direct-fired heater is evaluated. A typical calculation of this sort is shown below.

Example 1: A refinery fuel gas analyzing 70 per cent methane, 20 per cent ethane, and 10 per cent propane (by mol or volume) is being burned in refinery boilers. An orsat analysis of the flue gas shows 9.5 per cent CO_2, 4.2 per cent O_2, and 0.7 per cent CO. Flue gas exits at 500 F. Fifty thousand cubic feet per hour (standard temperature of 60 F, and standard pressure of 14.7 psia) of fuel gas are being used. Forty thousand pounds per hour of saturated steam at 185 psig are being produced. Bone-dry air is fed to the furnace at standard temperature and pressure. Make a performance calculation on the boiler operation.

Solution: A sketch of the process is shown as Fig. 1. A. The consistency of the fuel and flue gas analyses will be checked by assuming the flue gas analysis is correct and calculating the fuel analysis.

Assume a basis of 100 lb-mols of flue gas

Component	Mols	Mols equiv. O_2	Mols equiv. C
CO_2	9.5	9.5	9.5
O_2	4.2	4.2	.....
CO	0.7	0.35	0.7
N_2 (by diff.)	85.6	.....	.....
	100.0	14.05	10.2

The volume (mol) percentage of oxygen in air is *21*, the remainder being nitrogen (and other inerts).

Oxygen brought in with the Nitrogen $= \frac{0.21}{0.79} \times 85.6 = 22.8$ mols.

$22.8 - 14.1 = 8.7$ mols O_2 unaccounted for in the orsat.

This O_2 has reacted to form H_2O. Thus, there are $8.7 \times 2 = 17.4$ mols H_2O formed.

Calculated H/C ratio of fuel

$$(\text{lb/lb}) = \frac{17.4 \times 2}{10.2 \times 12} = 0.284$$

To obtain the actual H/C assume 1 mol of fuel,

Component	Mols	Mols equiv. C	Mols equiv. H_2
CH_4	0.70	0.70	1.40
C_2H_6	0.20	0.40	0.60
C_3H_8	0.10	0.30	0.40
	1.00	1.40	2.40

$$\text{H/C actual (lb/lb)} = \frac{2.40 \times 2}{1.40 \times 12} = 0.286$$

Therefore, the fuel and flue gas analyses are consistent. B. The per cent excess air is computed in terms of excess O_2.

From A, total O_2 fed 100/mols flue gas $= 22.8$.

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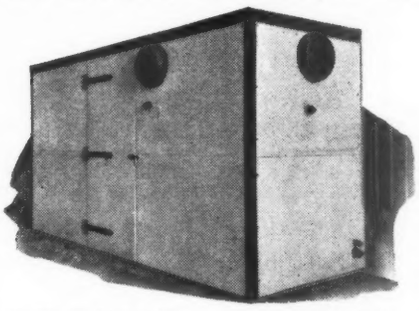

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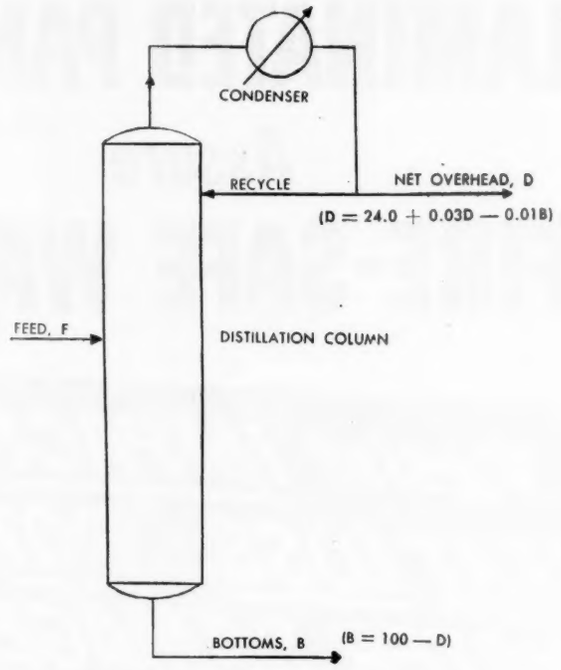


FIG. 2. Material balance on distillation column.

Required O_2 = 8.7 (to form H_2O) + 10.2 (to form CO_2 with all C present) = 18.9.

Excess O_2 = 22.8 — 18.9 = 3.9 mols.

$$\% \text{ Excess } O_2 = \frac{3.9}{18.9} \times 100 = 20.6$$

With a fuel gas of this analysis, about 20 per cent air is required for most economical combustion. Therefore, the air to fuel ratio is properly adjusted.

C. The thermal efficiency of the operation will be computed from an analysis of the heat in and the heat out.

Bases: (1) Datum plane for heat content will be 60 F
(2) Operation for one hour

Heat In: The net heat of combustion of a fuel gas of H/C = 0.286 is 1150 BTU/ft³ at 60 F and 14.7 psia.[1] (The net heat is used, since the water formed is not condensed out in the process.)

Sensible heat in with air and fuel = 0.

Heat in from burning = 1150 × 50,000 = 57.5 × 10⁶ Btu/hr.

Heat Out: To obtain total mols of flue gas per hour, the ratio of volume of flue gas to fuel volume may be obtained from Part A.

$$\frac{10.2 \text{ (mols C per 100 mols dry flue gas)}}{1.40 \text{ (mols C per mol fuel gas)}}$$

= 7.29 mols fuel gas per 100 mols flue gas.

Mols fuel gas per hr = 50,000/379 = 132.0 (379 ft³ is the gaseous molal volume at 60 F, and 14.7 psia).

$$\text{Mols dry flue gas} = 132.0 \times \frac{100.0}{7.29} = 1810$$

Mols wet flue gas = 1.174 × 1810 = 2125

Heat out in flue gas at 500 F,

Component	Mols, m	Cp[1]	Δt, F	q = mCpΔt, Btu/hr
CO_2	172	9.98	440	755,000
O_2	76	7.23	440	242,000
CO	13	7.04	440	40,000
N_2	1549	7.02	440	4,780,000
H_2O	315	8.19	440	1,133,000
	2125			6,950,000

q = 6.95 × 10⁶ Btu/hr

Heat out in steam = 40,000 × (1198.7 — 28.1) = 46.9 × 10⁶

Total heat out = 6.95 × 10⁶ + 46.9 + 10⁶ = 53.9 × 10⁶ Btu/hr.

Total heat in = 57.5 × 10⁶ Btu/hr.

$$\text{Unaccounted for heat loss} = \frac{57.5 - 53.9}{57.5} \times 100 = 6.25 \text{ per cent of heat input}$$

$$\text{Useful heat (to steam)} = \frac{46.9 \times 10^6}{57.5 \times 10^6} \times 100 = 81.5\% \text{ of heat input.}$$

It is often possible to apply both an overall material balance and an individual component material balance to a given unit, thereby facilitating the calculations. An example of this type is given below.

Example 2: It is desired to operate a fractionating column to remove the light ends from a natural gasoline fraction. The overhead should contain nothing heavier than isobutane and the bottoms should contain nothing lighter than propane. After observing the column characteristics it is thought that the overhead isobutane concentration should be set at 3 mol per cent and the bottoms propane concentration should be set at 1 mol per cent.

The feed composition is:

Component	*Mol per cent*
Methane	0.1
Ethylene	1.9
Ethane	5.0
Proylene	4.0
Propane	13.0
Isobutane	30.0
n-Butane	30.0
Pentane and heavier	16.0
	100.0

Make a material balance on the fractionator.

Solution: A sketch of the distillation column is shown as Fig. 2.

Basis: 100 mols feed to column
Let D = mols of overhead product
B = mols of bottoms product
Total mols propane = 13.0
Mols propane in bottoms = 0.01 B
Mols propane in overhead = 13.0 — 0.01 B
Mols butane in overhead = 0.03 D
All materials lighter than propane in overhead

D = 0.1 + 1.9 + 5.0 + 4.0 + (13.0 — 0.01 B) + 0.03 D

Overall material balance, B + D = 100

B = 100 — D

Substituting in the "D" equation for B and combining terms,

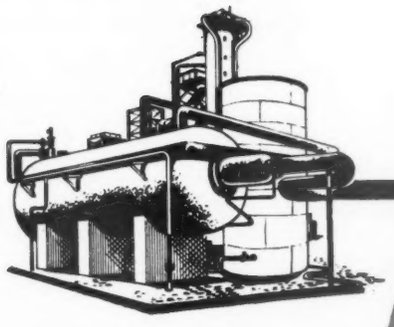
D = 24 — 0.01 (100 — D) + 0.03 D
D = 24 — 1 + 0.01 D + 0.03 D
0.96 D = 23
D = 24 mols; 0.03 D = 0.75
B = 76 mols; 0.01 B = 0.76

Composition of product streams:

Component	Overhead, mols	Bottoms, mols
Methane	0.1	....
Ethylene	1.9	....
Ethane	5.0	....
Propylene	4.0	....
Propane	12.2	0.8
Isobutane	0.8	29.2
n-Butane	....	30.0
Pentanes+	....	16.0
	24.0	76.0

A performance calculation will ordinarily involve the assumption that

[1]Chemical Engineering Fundamentals, C. G. Kirkbride, McGraw-Hill Book Co., 1947.



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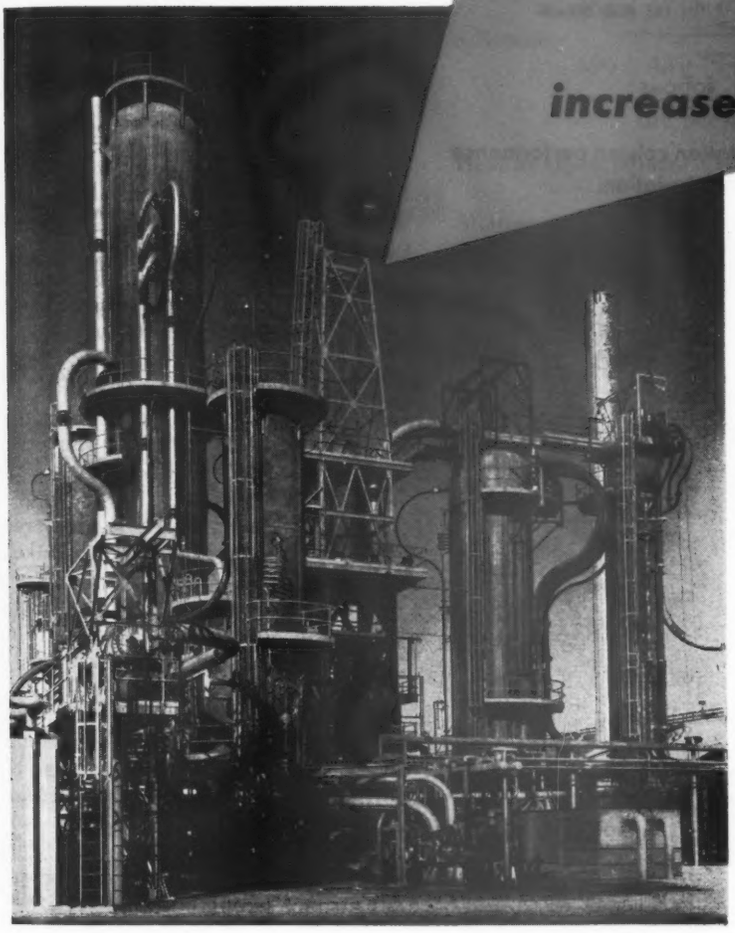

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values of certain operating conditions are correct, and values for other operating conditions will then be calculated. If the calculated conditions check with the actual, all the data are consistent and correct. If the calculated conditions do not check with the actual, the data are inconsistent, and the unit or process should be carefully examined to determine the cause of the inconsistency. Corrective measures should then be applied to improve the operation of the unit considered.

An example of the above-described procedure is given below, in making a performance calculation on a distillation column.

Example 3. It is desired to make a performance calculation on a distillation column. The following pertinent operating data have been obtained:

Stream Analyses, Mol %

Component	Feed	Net Overhead	Bottoms
Propane	11.0	45.9	
Isobutane	13.0	50.8	1.1
n-Butane	30.0	3.3	38.4
Isopentane	30.0	.....	39.5
n-Pentane	16.0	.....	21.0
	100.0	100.0	100.0

Flow Rates, gph at 60 F
- Feed, 1267
- Net Overhead, 274
- Bottoms, 993
- Recycle, 1096

Steam Rate, 1600 lb/hr (185 psig); [To Reboiler]

Column Pressure, psig; Top, 120; Bottom, 130

Process Temperatures, F
- Feed, 60
- Bottoms, 215
- Gross Overhead, 120
- Recycle and Distillate, 90

Solution: The material balance will be assumed correct, and the calculated reboiler steam rate will be compared with the actual.

Basis: Actual flows and conditions.

Feed

Component	mols	MW	Lb	Lb/Gal (60 F)[1]	Gal/hr
Propane	11.0	44	484	4.24	114
Isobutane	13.0	58	754	4.70	160
n-Butane	30.0	58	1740	4.86	358
Isopentane	30.0	72	2160	5.20	415
n-Pentane	16.0	72	1152	5.25	220
	100.0		6290		1267

Net Overhead

Component	mols	lb	GPH
Propane	11.0	484	114
Isobutane	12.2	707	150
n-Butane	0.8	47	10
	24.0	1238	274

[1]Natural Gasoline Supply Men's Association, Technical Manual, Fifth Edition, 1946.

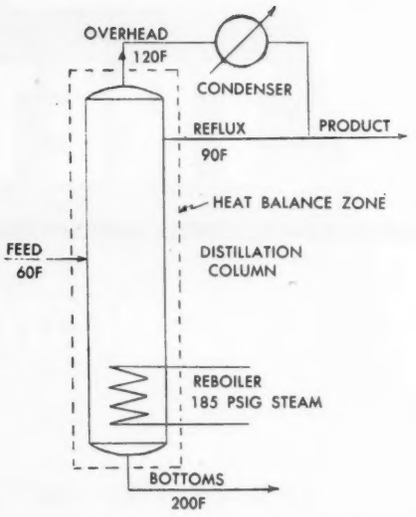

FIG. 3. Distillation column performance calculation.

Recycle

Component	mols	lb	GPH
Propane	44.0	1936	456
Isobutane	48.8	2128	600
n-Butane	3.2	188	40
	96.0	4252	1096

Bottoms

Component	mols	lb	GPH
Isobutane	0.8	47	10
n-Butane	29.2	1693	348
Isopentane	30.0	2160	415
n-Pentane	16.0	1152	220
	76.0	5052	993

Recycle Ratio = Recycle/Distillate = 1096/274 = 4/1

Gross Overhead = Distillate + Recycle = 5 (Net Overhead)

Gross Overhead

Component	mols	lb	GPH
Propane	55.0	2420	570
Isobutane	61.0	3535	750
n-Butane	4.0	235	50
	120.0	6190	1370

Heat balance: Datum, Liquid at 60 F. A diagram of the column is shown as Fig. 3.

Heat In = Heat in Feed + Heat in Steam + Heat in Reflux

Heat in reflux:

	Btu/hr
Propane = 1936 (33 — 15)† =	34,800
Isobutane = 2128 (33 — 14) =	40,400
n-Butane = 188 (29 — 14) =	2,800
Btu/hr	78,000

†All enthalpy values from Standard Oil Company (Indiana). Charts prepared by W. C. Edmister and D. H. Pollack in 1937.

Heat Out

Heat in gross overhead (120 F)

	Btu/hr
Propane = 2420 (197 — 15) =	440,400
Isobutane = 3535 (176 — 14) =	572,700
n-Butane = 235 (188 — 14) =	40,900
Btu/hr	1,054,000

Heat in Bottoms (215 F)

	Btu/hr
Isobutane = 47 (106 — 14) =	4,300
n-Butane = 1693 (100 — 14) =	145,600
Isopentane = 2160 (99 — 14) =	183,600
n-Pentane = 1152 (100 — 14) =	99,100
Btu/hr	332,000

Heat in Steam = 1,054,000 + 332,000 — 78,000 = 1,308,600 Btu/hr

It is assumed that latent heat only is removed from the steam. Latent heat of 185 psig steam is 843 Btu/lb

$$\text{Steam rate} = \frac{1{,}308{,}600}{843} = 1{,}552 \text{ lb/hr}$$

This checks closely with the actual steam rate of 1600 lb/hr. The other 48 lb/hr of steam can be attributed to heat loss.

It is sometimes desirable to operate a partial condenser in order to make a partial separation of components in a hydrocarbon mixture. This problem is unique in several respects, and for that reason Example 4, given below, is included.

Example 4: A partial condenser is in operation on a stream of hydrocarbons, and it is desired to make a performance calculation on the operation.

Data:
- System pressure, 310 psig (negligible pressure drop in condenser)
- Entrance temperature, 260 F
- Dew Point temperature, 135 F
- Exit temperature, 120 F
- Feed rate, 106,900 cu ft/hr (standard temperature and pressure)
- Vapor Effluent, 83,100 cu ft/hr (STP)
- Liquid Effluent, 668 gph (STP)
- Condenser Area, 1100 sq ft
- Cooling water: In at 85 F; out at 115 F

Stream Analyses

Component	Feed, mol %	Vapor Effluent, mol %	Liquid Effluent, Liquid Vol %
Methane	13.7	17.1	1.0
Ethane	20.6	23.5	9.5
Propylene	15.9	15.5	15.5
Propane	33.2	31.6	37.7
Isobutane	7.2	5.6	14.8
n-Butane	9.4	6.7	21.5
	100.0	100.0	100.0

Solution: A diagram of the condenser is shown as Fig. 4. The basis will be the actual flows and conditions as reported in the operating data.

Material Balance:

Component	Feed lb	Feed mols	Vapor Effluent lb	Vapor Effluent mols
Methane	618	38.6	600	37.5
Ethane	1743	58.1	1548	51.6
Propylene	1882	44.8	1428	34.0
Propane	4123	93.7	3049	69.3
Isobutane	1177	20.3	713	12.3
n-Butane	1537	26.5	853	14.7
	11,080	282.0	8191	219.4

Liquid Effluent

Component	Vol, gal.	lb/gal (60 F)	MW	mols
Methane	7.0	2.5	16	1.10
Ethane	63.6	3.11	30	6.60
Propylene	103.5	4.35	42	10.70
Propane	251.6	4.23	44	24.20
Isobutane	99.0	4.69	58	8.00
n-Butane	143.3	4.86	58	12.00
	668.0			62.60

$$\text{Mols feed} = \frac{106{,}900}{379} = 282.0$$

$$\text{Mols vapor effluent} = \frac{83{,}100}{379} = 219.3$$

Mols feed = mols liquid effluent + mols vapor effluent

Mols feed = 62.6 + 219.3 = 281.9

Actual mols feed = 282.0 (above); thus, have very close check.

Heat balance: (Above liquid at 60 F)

Heat in = Heat in feed (260 F and 325 psia)

Btu per hour

Methane = 618 (222 — 18) = 126,000

Ethane = 1743 (266 — 23) = 424,000

Propylene = 1882 (250 — 16) = 440,000

Propane = 4123 (248 — 15) = 961,000

Isobutane = 1177 (224 — 14) = 247,000

n-Butane = 1537 (224 — 14) = 322,000

Btu per hour 2,520,000

Heat out = Heat in liquid effluent + heat in vapor effluent + heat in cooling water

Heat in liquid effluent (120 F)

Btu/hr

Methane = 18 (64 — 18) = 800

Ethane = 198 (113 — 23) = 17,800

Propylene = 450 (52 — 16) = 16,200

Propane = 1064 (50 — 15) = 37,200

Isobutane = 464 (47 — 14) = 15,300

n-Butane = 696 (45 — 14) = 21,600

Btu per hour 108,900

Heat in vapor effluent (120 F)

Btu per hour

Methane = 600 (138 — 18) = 72,000

Ethane = 1548 (192 — 23) = 262,000

Propylene = 1428 (176 — 16) = 228,000

Propane = 3049 (174 — 15) = 485,000

Isobutane = 713 (176 — 14) = 115,000

n-Butane = 853 (188 — 14) = 149,000

Btu per hour 1,311,000

Heat in cooling water = 2,520,000 — 1,311,000 — 108,900

Heat in cooling water = 1,100,000 Btu per hour

Check on heat transfer. Countercurrent flow is used in the condenser. The performance calculations on the heater will be made using two simulated sections in the condenser. One section is used for desuperheating the vapor, while the other is used for condensing and sub-cooling the liquid. A schematic diagram of the temperature distributions is shown as Fig. 5. In order to calculate the heat removed in each section of the condenser, the heat in the vapor at the dew point (135 F) must be known.

Heat in vapor at dew point:

Btu per hr

Methane = 618 (146 — 18) = 79,100

Ethane = 1743 (200 — 23) = 308,000

Propylene = 1882 (185 — 16) = 308,000

Propane = 4123 (175 — 15) = 660,000

Isobutane = 1177 (180 — 14) = 195,000

n-Butane = 1537 (192 — 14) = 274,000

Btu per hour 1,824,000

Heat removed from vapor = 2,520,000 — 1,824,000 = 696,000 Btu per hour

Heat removed in condensing region = 1,100,000 — 696,000

Heat removed in condensing region = 404,000 Btu per hour

Total cooling water rise = 30 F (from operating data)

Cooling water rise in condensing section $= 30 \times \frac{404{,}000}{1{,}100{,}000} = 11$ F

Cooling water rise in de-superheating section = 30 — 11 = 19 F

Condenser, Section 1 (Cooling water to vapor).

Design basis, U (overall heat transfer coefficient) = 10 Btu/(hr) (ft²) (°F)

This value for U will be assumed, and the area checked.

Heat transferred, $q = UA\Delta t_m = 696{,}000$ Btu/hr

$$\Delta t_m = \frac{(260 - 115) - (135 - 96)}{\ln \frac{(260 - 115)}{(135 - 96)}} = 80.5$$

$$A = \frac{696{,}000}{10 \times 80.5} = 865 \text{ ft}^2$$

Condenser, Section 2 (Cooling water to condensing vapor).

Design basis, U = 50 Btu/(hr) (sq ft) (°F)

Heat transferred, $q = U A \Delta t_m = 404{,}000$ Btu/hr

$$\Delta t_m = \frac{(135 - 96) - (120 - 85)}{\ln \frac{(135 - 96)}{(120 - 85)}} = 37.8$$

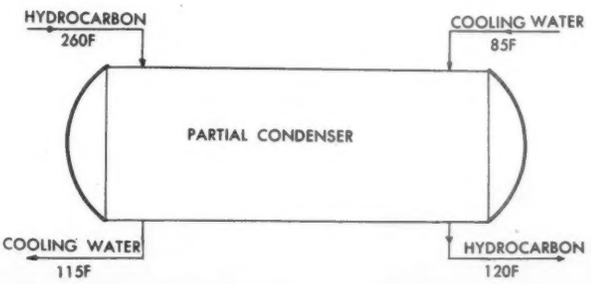

FIG. 4. Partial condenser performance calculation.

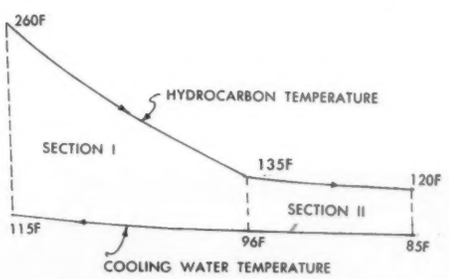

FIG. 5. Temperature distribution in partial condenser.

$$A = \frac{404{,}000}{50 \times 37.8} = 214 \text{ sq ft}$$

Total A = 214 + 865 = 1079 sq ft
This checks closely with actual area of 1100 sq ft.

In processes for cracking gas oil to gasoline it is necessary to recycle some gasoline with the recycle gas oil, since complete separation by fractionation is economically unfeasible. Example 5 shows how the gasoline recovery is reduced, due to the presence of this recycle gasoline.

Example 5: A thermal cracking process is operating so that virgin gas oil is fed to a cracking furnace in a one-pass operation, with a yield of 20 per cent crack per pass (liquid volume). The recycle gas oil, after separation of tar, gas, and gasoline, is fed to a separate furnace and cracked at 10 per cent per pass to ultimate yields. Calculate the net yield of gasoline obtained and make a material balance on the process.

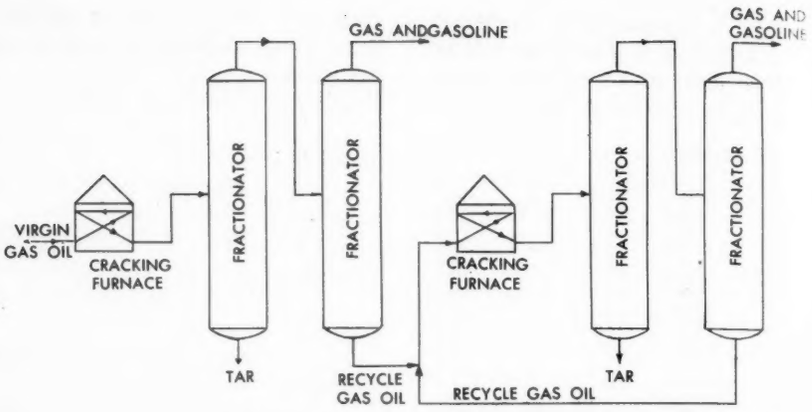

FIG. 6. Gas oil cracking process.

Additional Data

Maximum theoretical gasoline yield from virgin gas oil is 65 per cent by volume.

Recycle gas oil contains 12 per cent by volume of gasoline.

Twelve per cent crack per pass of gasoline in recycle gas oil to gas and tar.

Solution: A diagram of the process is shown in Fig. 6.

Basis: Virgin gas oil charge = 1000 gallons.

Gasoline yield from virgin gas oil crack = 200 gallons.

Maximum ultimate gasoline yield = $1000 \times 0.65 = 650$ gallons.

Maximum possible gasoline yield from recycle gas oil crack = 650 − 200 = 450 gal.

Recycle Gas Oil Cracking

Let X = recycle gas oil charge, gal

0.12X = gasoline in recycle gas oil, gal

Loss of gasoline (due to cracking to gas and tar) = (0.12)(0.12X) = 0.0144X

Gasoline produced per pass = 0.10X

Net gasoline produced + gasoline lost = Maximum possible gasoline production

Thus, $0.10\,X + 0.0144X = 450$

$X = 3934$ gal

Net gasoline yield = Gasoline from virgin gas oil + gasoline from recycle gas oil

Net gasoline yield = 200 + (3934)(0.10) = 593 gal

Loss due to gasoline in gas oil recycle = 650 − 593 = 57 gal.

* * *

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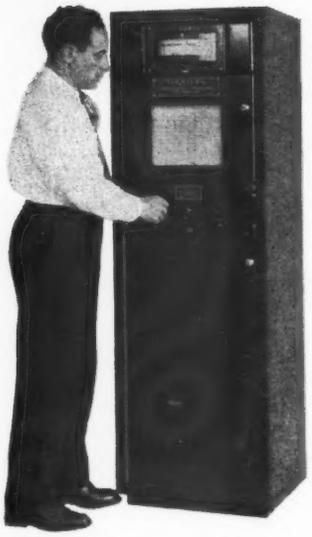

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Model 26-102

Accurate control of the odorization of natural gas is a major problem facing many gas distribution companies today. The importance of odorizing gas to a known and fixed level, in order to assure its safe and economical distribution, is ever increasing with the rapid expansion of natural gas utilization.

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The Titrilog quantitatively records sulfur compounds such as H_2S, SO_2, mercaptans, thioethers, thiophene, and organic disulfides in concentrations as low as 0.1 ppm or 0.005 grains per 100 cubic feet. Compounds of specific interest may be separately determined over a wide range of concentrations.

For complete information on the Consolidated Titrilog and other applications, such as problems in corrosion, sour-gas treating, etc., write for Bulletin CEC-1810-X16.

SPECIFICATIONS

Sensitivity The Titrilog quantitatively records oxidizable sulfur compounds in concentrations as low as one part in ten million or 0.005 grains per 100 cubic feet.

Power Requirements The Titrilog operates on standard 60-cycle 115-volt power. It requires approximately 6 amperes.

Cabinet Dimensions The Model 26-102 Titrilog is housed in a floor-mounted cabinet 66-inches high, 22½-inches wide, and 18½-inches deep. The strip-chart recording milliammeter is mounted at eye level, and directly below it is the control panel.

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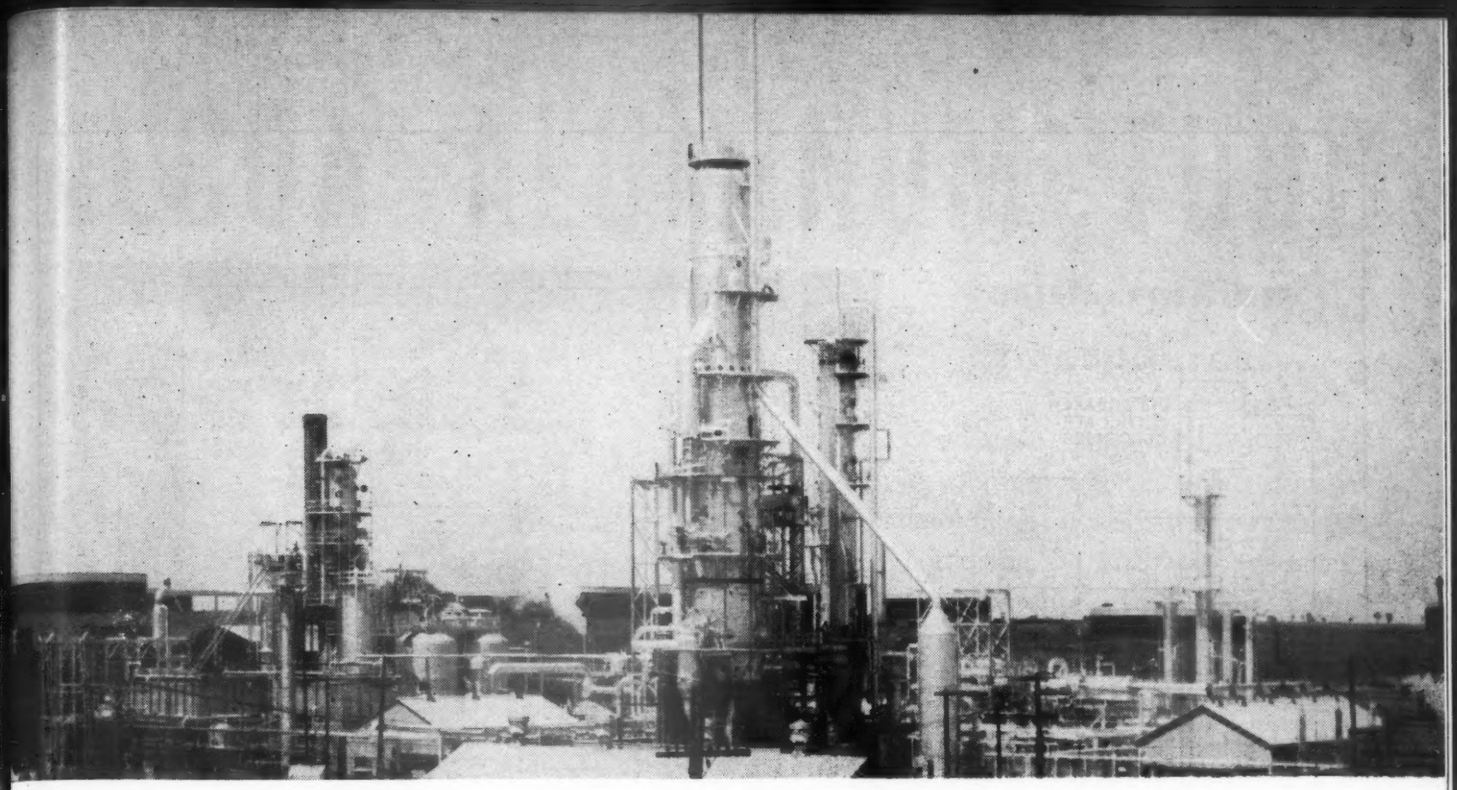

At extreme left is vis-breaking section where catalytic charge stock is prepared. The reactor-generator section of the catalytic cracking unit and main fractionating tower appear in the center foreground with the gas-concentration unit on the right.

P 731.

Deep Rock Builds Today for Tomorrow

Improvement in Cushing plant provides additional octane numbers; produces more distillate fuel oil instead of heavy residual type

W. T. ZIEGENHAIN

TYPIFYING the desire of refiners to further improve the octane values of their respective gasolines, Deep Rock Oil Corporation has perfected major revisions in its Cushing, Oklahoma plant. Steps have also been taken to allow for the plant's further expansion. While the discussion here and accompanying flow charts depict the main effects of installing the new catalytic cracking unit, credence must be given the idea that interlocking auxiliary equipment could be added to further increase the plant's overall capacity.

A typical charge of crude oil now coming to the refinery has the following characteristics:

Gravity	37-39 API
BS	0.2 per cent

As this is received, it is processed through the new topping unit where a light straight run gasoline is distilled off. The crude, after being thus reduced serves as the charging material for the unit under later discussion here.

Vis-Breaker

One of the new units is referred to as the vis-breaker and to this the topped crude is first pumped. On its way there it passes through 2 tubular heat exchangers where heat is absorbed and in turn, the temperature of the vapor overhead of the vis-breaker flash chamber is reduced. The topped crude entering this series of exchangers is approximately 550 F. The oil coming from the vis-breaker heater then enters the flash chamber at about 900 F. The overhead product next passes to the vis-breaker gas oil accumulator tank and from here the bulk is recovered as gas oil charging stock for the catalytic cracking unit.

Obviously it is necessary for the practical balancing of the operation of this unit and no attempt is here made to enumerate the various means afforded. The relationship of this unit to the plant operation generally, can best be seen by referring to the accompanying flow charts.

Cat Cracker

A typical charge to the fluid catalytic cracking unit is as follows:

Gravity	29.0
Initial	350
Per cent @ 400 F	10
Per cent @ 700 F	60
Conradson carbon	0.3

The catalyst used is a solid of very fine powdery consistency. Normal losses on this material approximate 0.5 lb per bbl of raw oil charged to

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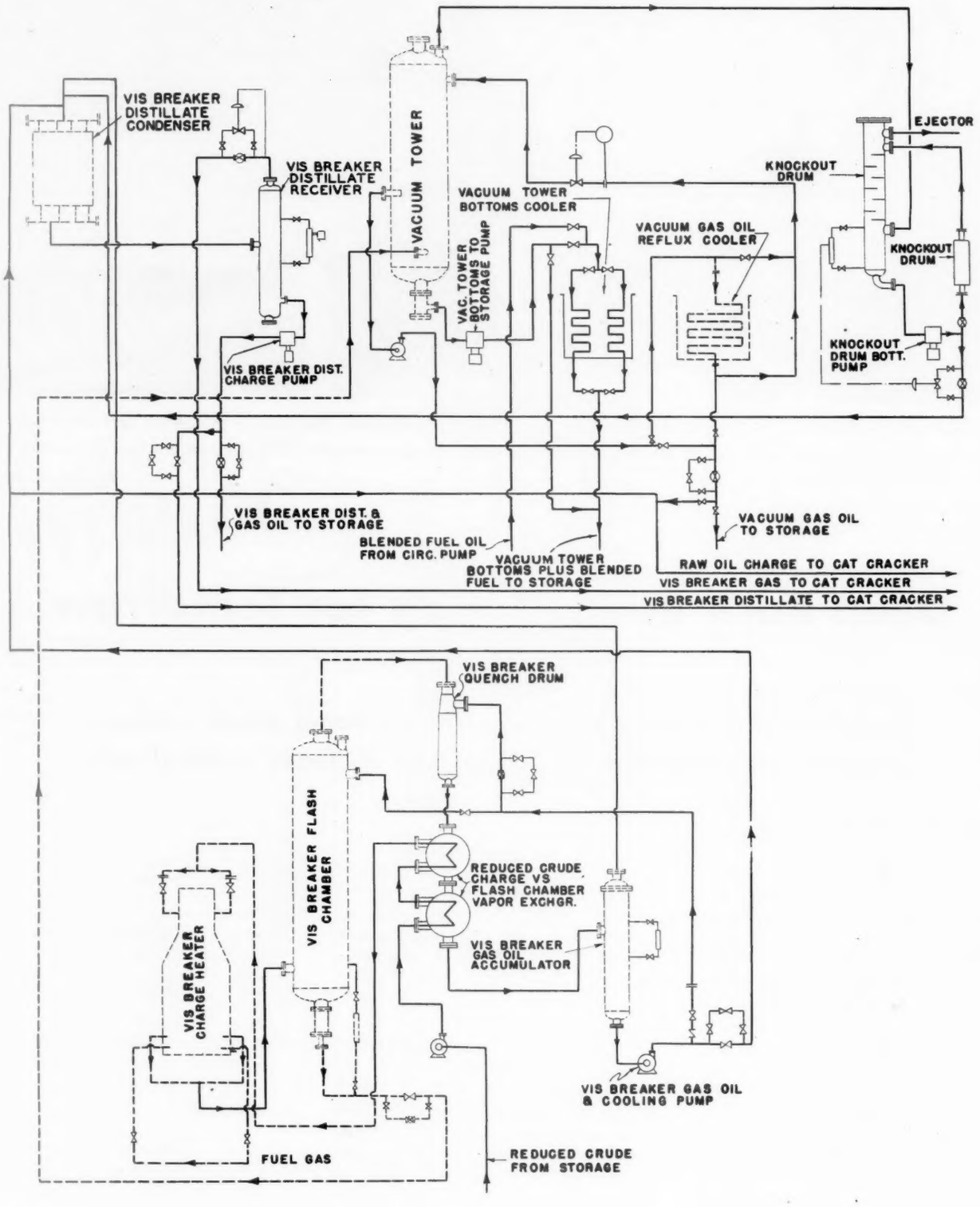
VIS BREAKER DISTILLATE CONDENSER
VIS BREAKER DISTILLATE RECEIVER
VACUUM TOWER
VACUUM TOWER BOTTOMS COOLER
VAC. TOWER BOTTOMS TO STORAGE PUMP
VACUUM GAS OIL REFLUX COOLER
EJECTOR
KNOCKOUT DRUM
KNOCKOUT DRUM
KNOCKOUT DRUM BOTT. PUMP
VIS BREAKER DIST. CHARGE PUMP
VIS BREAKER DIST. & GAS OIL TO STORAGE
BLENDED FUEL OIL FROM CIRC. PUMP
VACUUM TOWER BOTTOMS PLUS BLENDED FUEL TO STORAGE
VACUUM GAS OIL TO STORAGE
RAW OIL CHARGE TO CAT CRACKER
VIS BREAKER GAS TO CAT CRACKER
VIS BREAKER DISTILLATE TO CAT CRACKER
VIS BREAKER QUENCH DRUM
VIS BREAKER FLASH CHAMBER
REDUCED CRUDE CHARGE VS FLASH CHAMBER VAPOR EXCHGR.
VIS BREAKER GAS OIL ACCUMULATOR
VIS BREAKER CHARGE HEATER
VIS BREAKER GAS OIL & COOLING PUMP
FUEL GAS
REDUCED CRUDE FROM STORAGE

FIG. 1. VIS BREAKER FLOW CHART

Through this equipment reduced crude passes to provide overhead for cat cracker.

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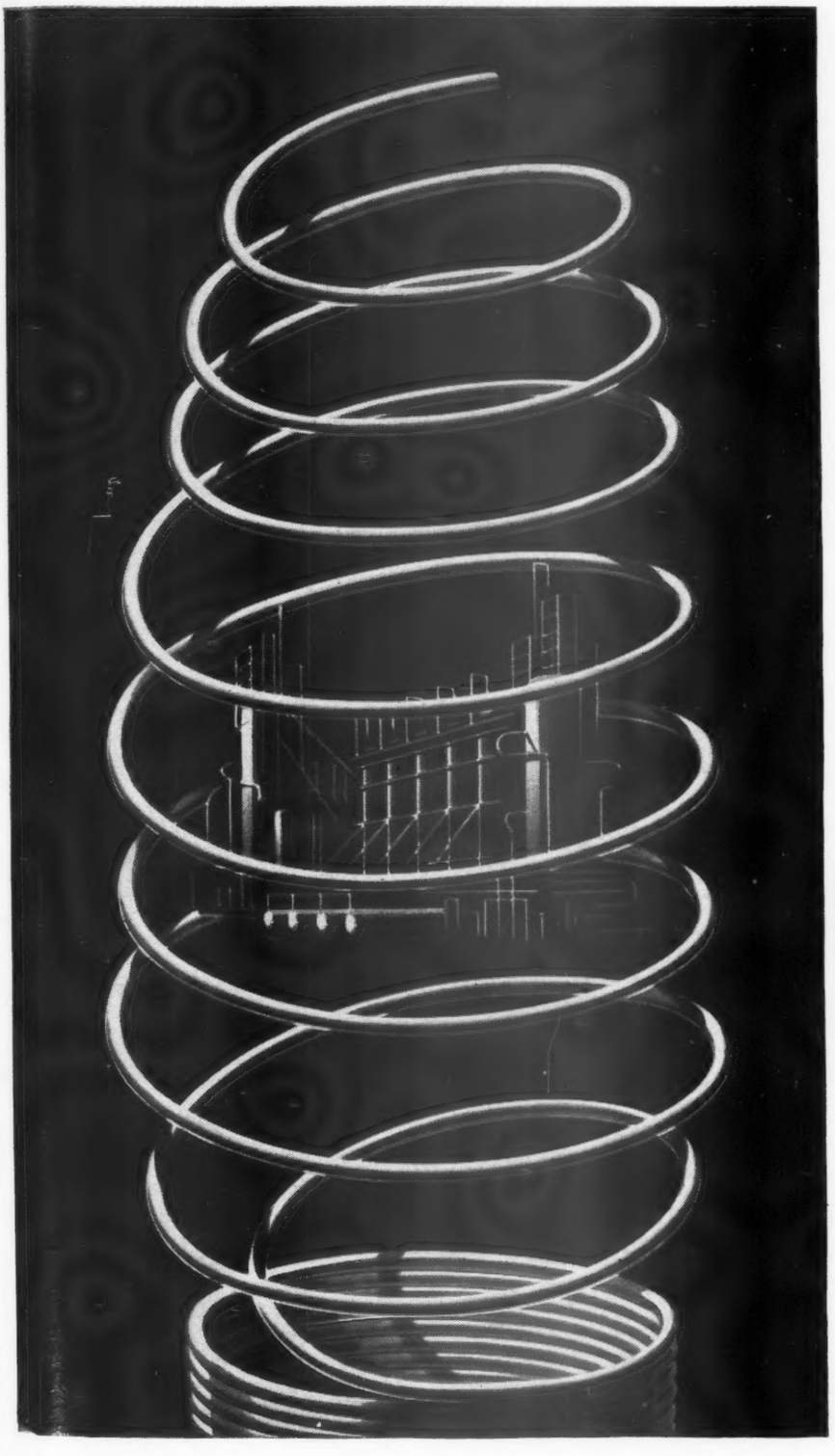

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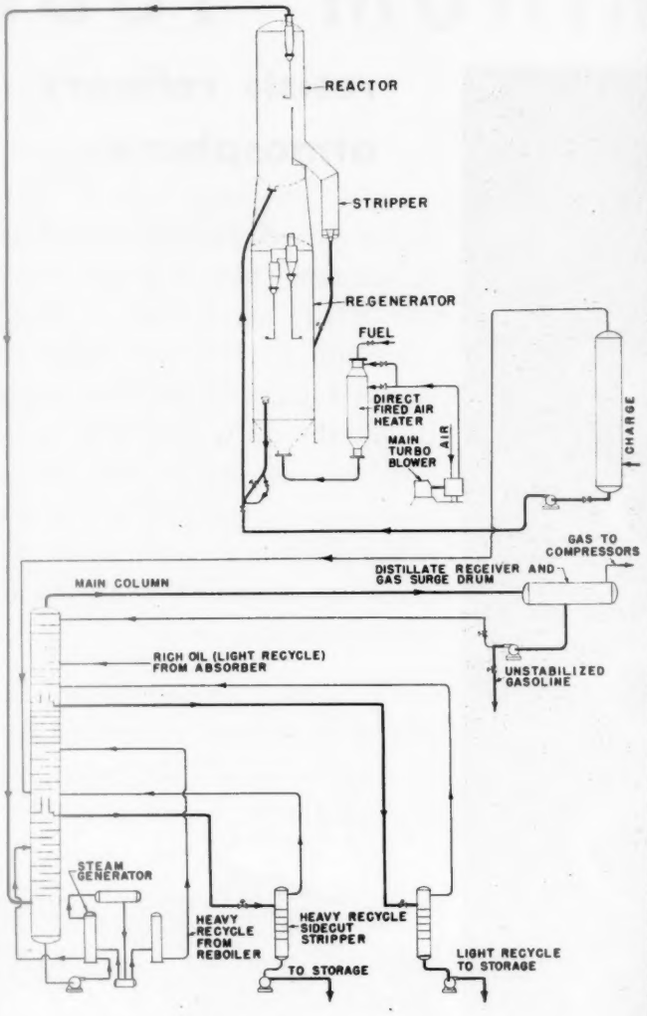
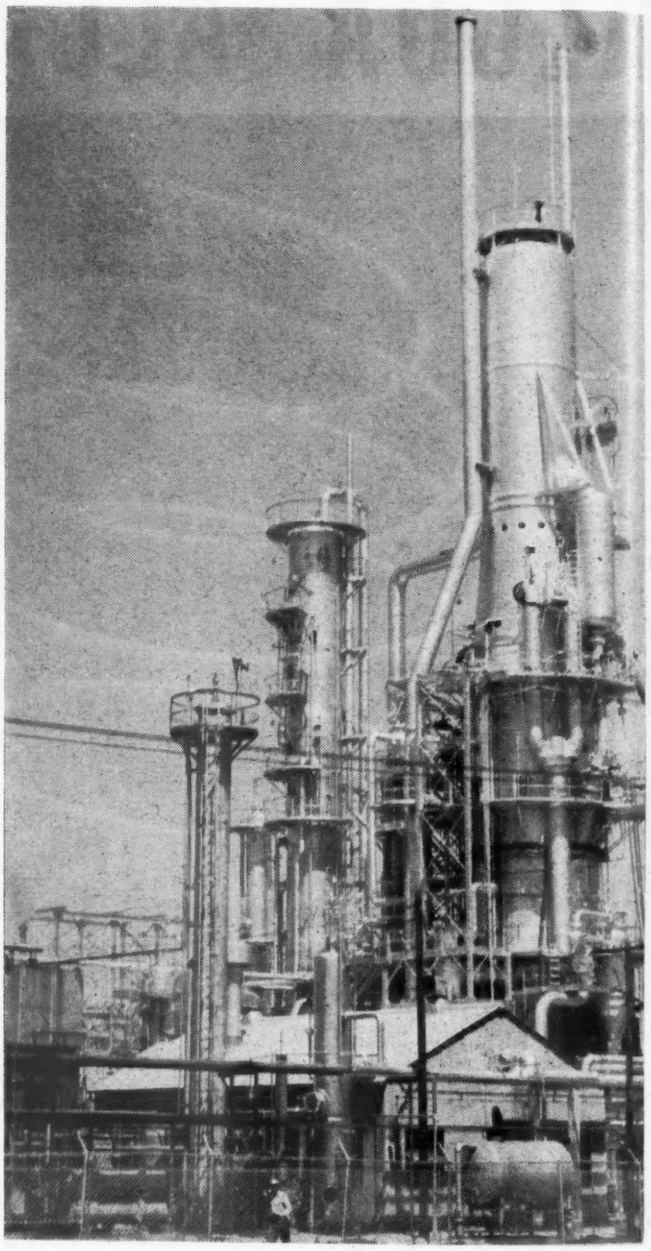


FIG. 2. SIMPLIFIED FLOW CHART OF CAT CRACKER

The reactor appears in upper section to give sufficient head for revivification of catalyst.



General view of catalytic cracking unit showing the reactor mounted above the catalyst regenerator. Various fractionating columns are shown to the left.

the unit. Because the catalyst is revivified within the unit as shown by the accompanying flow chart there is no definite knowledge yet of just what this amount will be. Suffice it is to say that the replacement of catalyst thus far has been a negligible factor.

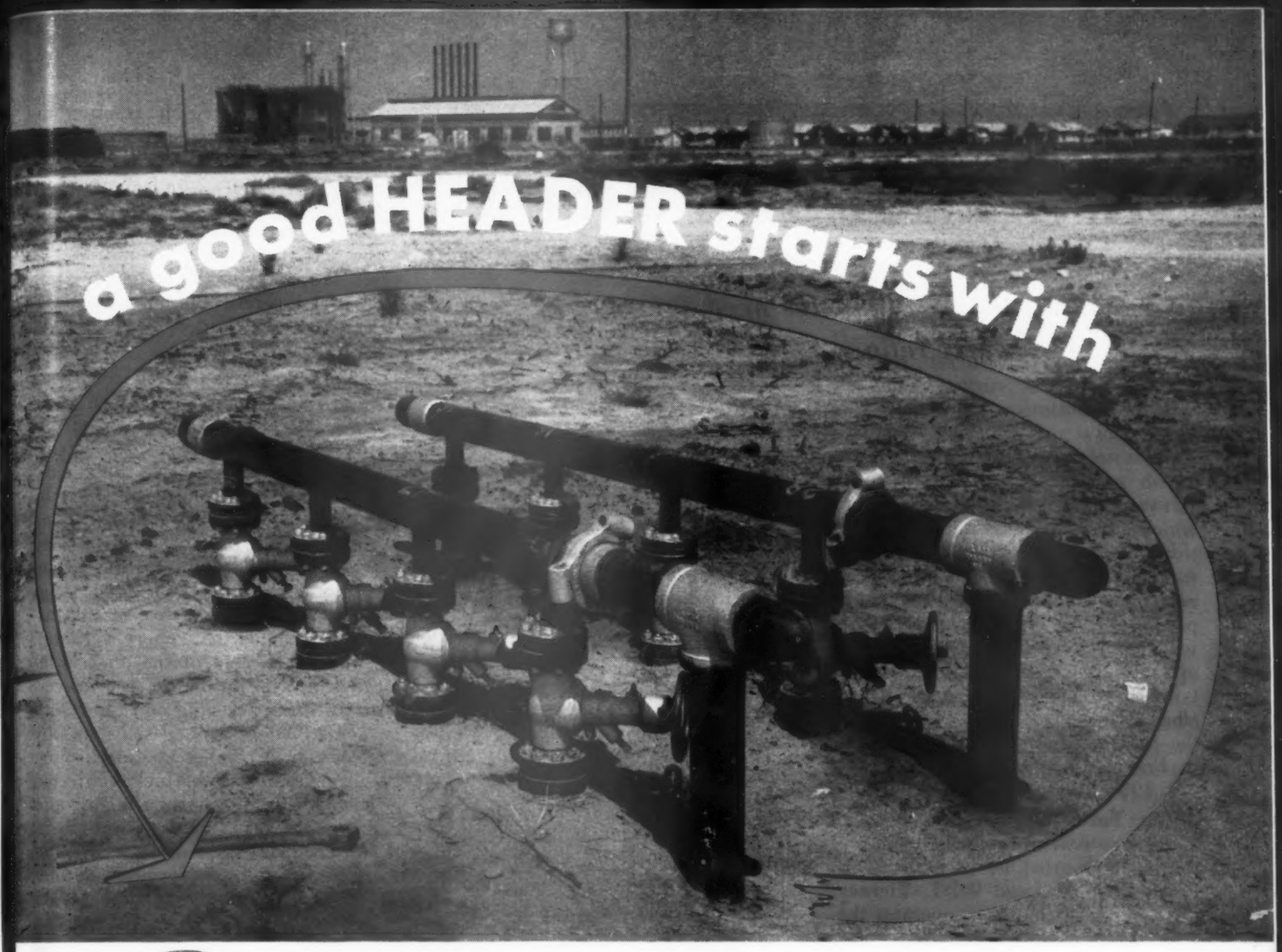
This charge first passes to a vertical drum of 240 bbl capacity. From here this is continuously fed to a reactor where it mixes with the finely powdered catalyst. The powdered, fluidized catalyst promotes selective cracking of the gas oil charge to the desired yields of catalytic gasoline. The reactor is a vertical vessel, the top of which is approximately 150 ft above ground, and is mounted atop the catalyst regenerator.

Unstabilized gasoline from the reactor has the following typical characteristics:

Gravity °API	58.0
IBP	100
10%	140
50%	240
90%	380
EP	415
RVP	10 lb
Octane No.	90 (Res.)

Light and heavy cycle oils are obtained as side cuts from the main fractionating column. The light cycle oil is blended to produce heating oils. The heavier cycle oil mentioned previously may be blended to fuel oil or may be thermally cracked. With this, alternate provision flexibility is provided.

Mindful of the overall improvements in the octane value of the gasoline made, together with the flexibility and expansion provided, it is only logical that we may expect to hear more about this plant in the future. *



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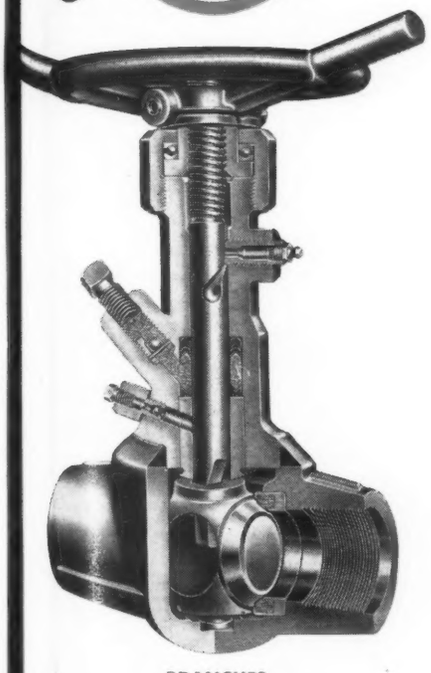

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NEW KNOCKLESS ENGINE

TCP design eliminates need for fuels of high octane ratings or limited end points.

ARCH L. FOSTER*

DEVELOPMENT of an engine design which throws octane numbers practically into the discard, if we are to judge by the facts reported, has been accomplished by The Texas Company's Beacon, New York Laboratories. Details of this engine design, its operation, the results obtained and the types of fuels that may be burned efficiently by it were reported before the Society of Automotive Engineers in French Lick, Indiana at its June 4-9, 1950 meeting.

The Texaco Combustion Process (TCP) as developed by that laboratory and reported by E. M. Barber, Blake Reynolds, and W. T. Tierney of The Texas Company, operates the combustion cycle of the Otto Cycle engine so that knock does not occur regardless of the octane number of the fuel or the compression pressure or degree of supercharge of the engine. This result is accomplished by the production of a swirling action in the air and fuel in the cylinder, by which no pocket of fuel-air mixture is held at any point to reach the auto-ignition temperature to produce knock. The principle of this swirling air supply is shown in comparison with the combustion principles of the regular spark-ignition engine in Figs 1 and 2; (Figs 1 and 3 in the Report); Fig 1 is the principle employed in the combustion of the conventional engine cylinder; in this system the "end gas" pocket at the lowest point in the cylinder drawing is that which produces the 'knock' or 'ping'. In Fig. 2 is shown the principle of the TCP process whereby the knocking mass of fuel-air mixture at the end of the combustion cycle is eliminated, thus eliminating knock.

Because of this elimination of the need for high anti-knock properties the new system will burn efficiently wide boiling fuels, with ranges of 100 F to 600 F. It also permits the proper and efficient combustion of very lean fuel-air mixtures, thus bringing full load efficiency to part-load or idling operations, a fact that is impossible to accomplish in the conventional engine. Compression ratio may be increased with no regard for octane ratings of fuels. Supercharge may be employed also, the researchers report, along with high compression pressure without regard to octane rating. Consequently this new combustion cycle can employ fuels with *no* octane rating specification, and with fuels of a very wide boiling range. Because of this wide boiling range the percentage of a barrel of crude that may be used as fuel in automotive engines is increased from 54 per cent for the conventional engine to 71 per cent in the TCP engine, the report states.

In discussing the relationship between ignition delay and knock or detonation, the paper points out that this may be likened to a race between the spontaneous ignition reactions of the end gas mixture, and the normal progress of the flame initiated by the spark plug. Whichever reaction develops first determines the actuality of absence of detonation. High octane number fuels have a high spontaneous ignition resistance that permits the normally initiated flame front to win the race against the spontaneous ignition properties of the fuel-air mixture at high temperature and pressure levels in the engine cylinder.

One of the principles of the TCP idea is to make the residence time of the fuel in the cylinder so much shorter than the ignition delay period that spontaneous ignition, i.e., knock, cannot occur. This residence time of the combustion mixture is controlled by injection of the fuel into the compressed air in the cylinder and may be varied by varying the time of injection as related to the given point in the compression stroke of the piston. To quote the report verbatim "The first element of fuel that is injected mixes with the air as it travels toward the spark plug and the resultant mixture is ignited substantially as soon as it reaches the spark plug. The remainder of the fuel is injected continuously into the swirling air and during this continuing injection a flame front is established; fresh combustible mixture is formed continuously and fed into the flame front and combustion products are carried away from the flame front."

By terminating the fuel injection before all the swirling air has been mixed with fuel it is possible to burn very lean overall mixtures, thus obtaining high part-load efficiencies, and to control the engine power by control-

FIG. 1. Otto cycle engine. Octane requirement.

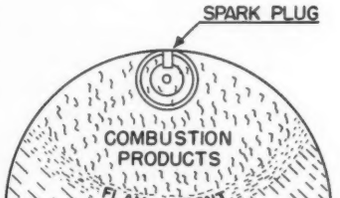
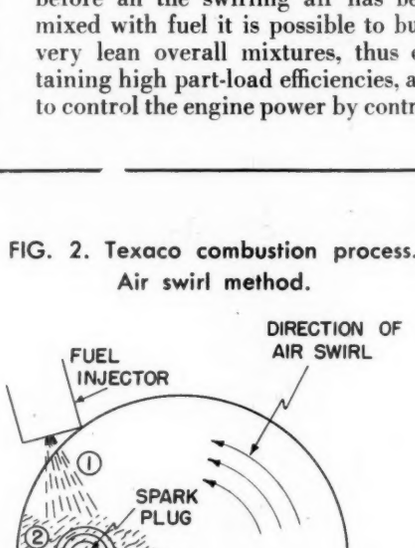


FIG. 2. Texaco combustion process. Air swirl method.



1-FUEL SPRAY
2-COMBUSTIBLE AIR-FUEL MIXTURE
3-FLAME FRONT
4-COMBUSTION PRODUCTS

*Refining and Gas Processing Editor.

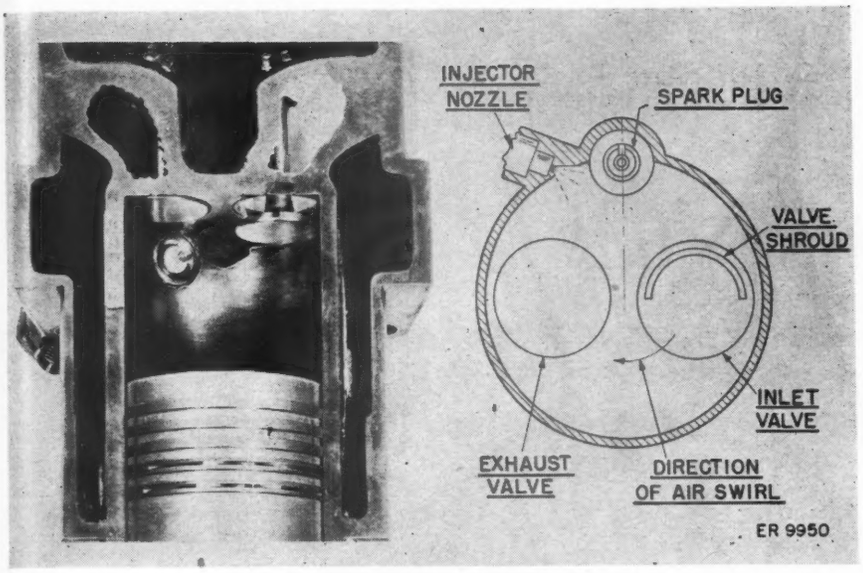


FIG. 3. Experimental apparatus. General arrangement.

ling variation in fuel quantity without throttling the air.

Engine Characteristics

The system employed in the TCP engine, and a photographic view of one of the earlier engines are shown in Fig 3 (Fig 4 in the Report). This particular cylinder is the four-cycle poppet valve type, 3¼-in. bore by 4½-in. stroke. The intake valve is shrouded to induce swirling of the air intake, at approximately 30 deg of arc, downstream from the injector position. Many different designs of cylinder have been employed in research experiments, of both two-cycle and four-cycle design, up to 6-in.-bore, 6-in.-stroke units. In all of these designs, these common features have been scheduled: Method for creating air swirl, relative positions of injector and spark plug, and a combustion chamber that is "essentially a figure of revolution."

With an engine so arranged the operation is free of the influence of octane or cetane numbers, and relatively insensitive of the volatility of the fuel.

In investigating the knock tendencies of the various fuels under widely differing conditions the most common set of operating conditions has been in the range of 1800 rpm, 10:1 compression ratio, a 90 F air intake temperature with 212 jacket temperature; a manifold pressure of 30-60-in. Hg absolute, on a 24-octane number fuel of 100-600 F boiling range. The range of conditions which have been tested and found knock-free and those shown in Table 1 (Table 1 in Report). Experiences in accelerations, and under quick load changes, etc., operation without spark or injector adjustments has been possible, and the resulting impression is that of very flexible operation possibilities.

Limitation of residence time is, among other factors, a function of the relative location of the injector and the spark plug. Other factors are the character of the fuel spray and relative timing of fuel injection and ignition. Injection produces a "patch" or area in which fuel and air are mixed, which increases in extent until it becomes so large that in some part of it the residence time, before spontaneous ignition occurs, is exceeded and detonation occurs. Experience shows that knock-free operation is obtainable when the spark plug is located between 30 and 60 deg downstream from the injector. At 90 deg downstream a borderline of knock operation occurs, and beyond 90 deg the engine knocked. Thus a reasonable range of choice is permitted the designer in the location of plug and injector.

Another important factor in the operation is that of the characteristics of the fuel-spray. This spray must not be long and concentrated enough to go beyond the plug before ignition, must not concentrate enough to make the mixture near the plug too rich for ignition, but must be strong enough to avoid too much deflection near the plug by the swirling air. This range of spray is relatively broad, to escape knocking.

Experience has shown that spark timing, within the "spark tolerance" of the engine, has little effect on the engine's power output. In general, spark timing has proved to be, not an independent variable but is dependent on injection timing. The ignition tolerance band, however, is wide and often a fixed spark is satisfactory through the entire speed-load range.

The flexibility of this new design is indicated by this expression voiced by the authors; "These three factors—the location of the injector and spark plug; the direction and character of

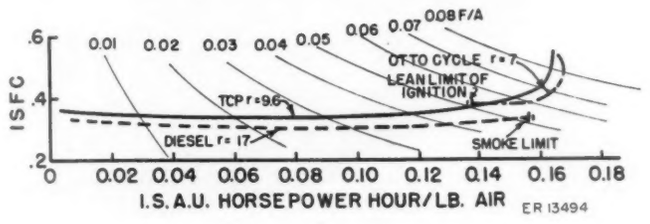
TABLE 1. Texaco combustion process, range of knock-free operation.

Compression Ratio	6-12.
Manifold pressure	10-120 in. of HG ABS.
Jacket temperature	212-375 F.
Intake air temp.	90-400 F.
Speed	200-4400 RPM.
Load	Idle to full load at any speed.
Flexibility	Acceleration and rapid load change at any condition.
IMEP	20 to greater than 400 psi.
Fuels	Iso pentane, alcohol, benzene, kerosene, diesel fuel, tractor fuel, triptane, iso octane n-heptane, cetane, δ-Methyl-naphthalene (and others).

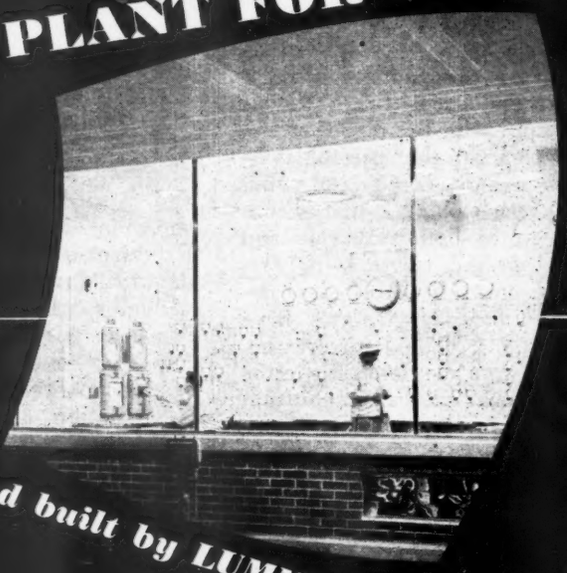
FIG. 4

COMPARATIVE PERFORMANCE

(AUTOMOTIVE SIZE ENGINES)



NEW LUBE OIL PLANT FOR SOHIO



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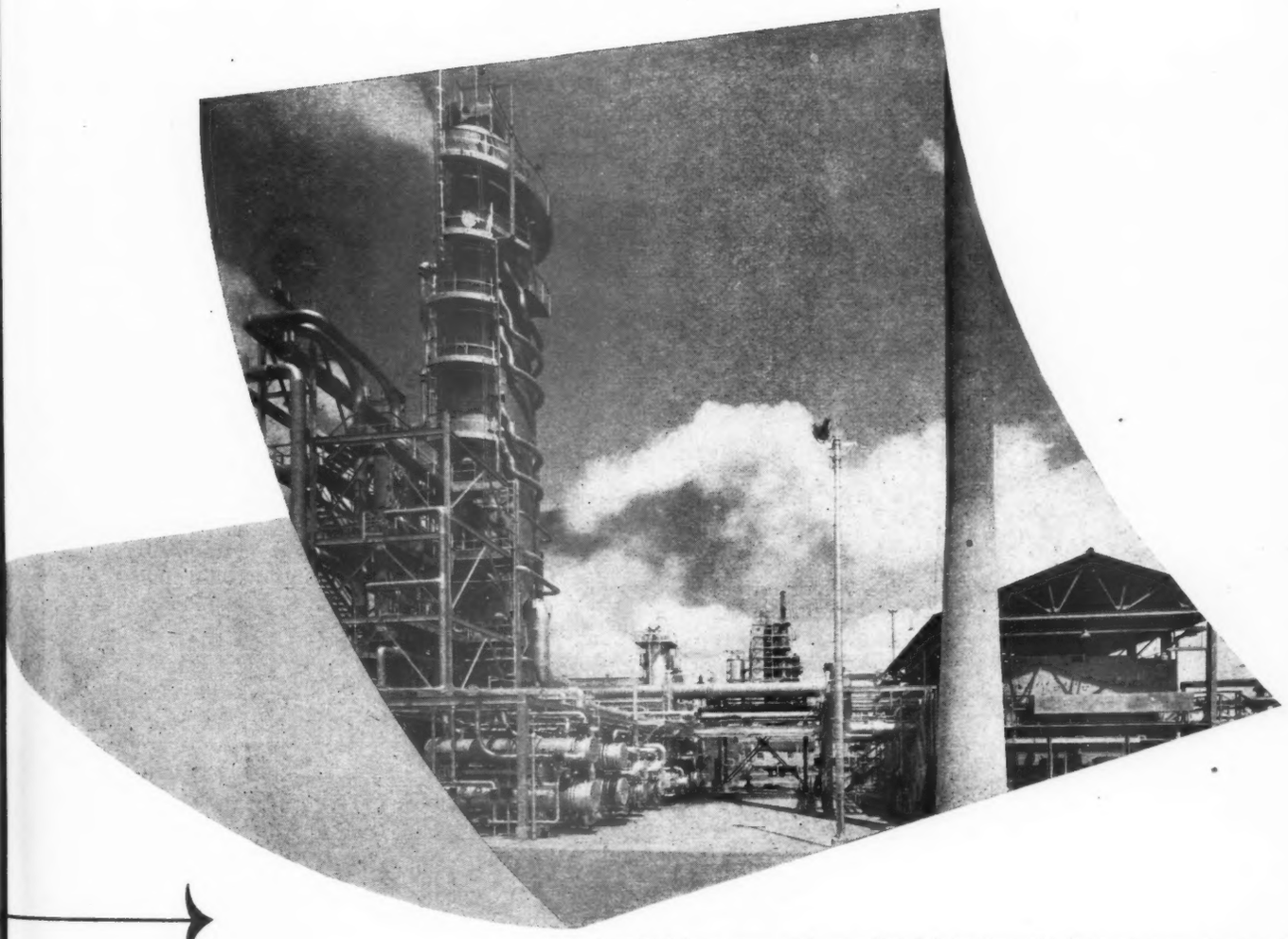
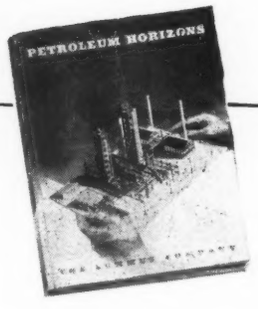


In mid-July a new and complete lubricating oil plant went on stream at SOHIO's large Lima refinery. Lummus designed and built four of the five processing units which will produce approximately 1800 barrels per day of high grade lubricating oils.

Lummus applied new and improved techniques in the design of SOHIO's lube-oil plant. A new fluidized method of clay handling is employed in the contact units. A hot oil-belt system provides all the heat required for the FURFURAL, MEK, and CLAY-CONTACT Units. A single console instrument panel is used to control the operation of the FURFURAL and MEK Units.

The Lima plant reflects the leading role Lummus has played in the building of outstanding lube-oil refineries. Lummus has designed and constructed over 115 lubricating oil processing units. To a study of your individual problems, whether solvent refining, the modernization and expansion of existing units, or new projects, Lummus can add the experience gained through years of designing and building petroleum, petroleum chemical and chemical plants.



PETROLEUM HORIZONS, the new 80-page book on Lummus processes and plants, features a step-by-step description and flow sheets for 31 refinery processes. Your copy available on request.

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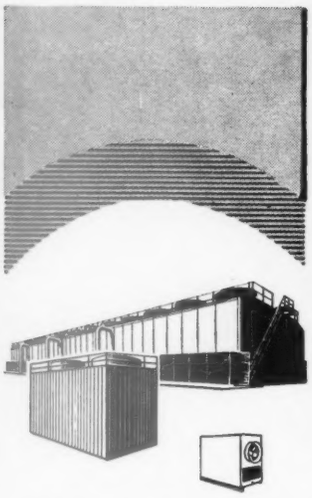
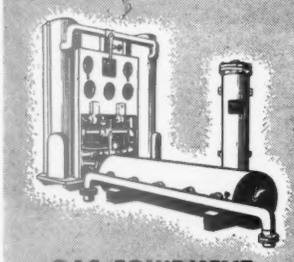
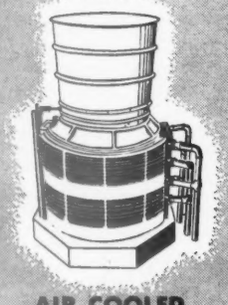


COOLING TOWERS



GAS EQUIPMENT



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We could, and we did. A few months later the Pritchard series "J" Induced Draft Cooling Tower with separate coil shed pictured above was put into operation.

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Naturally, when additional water cooling capacity was needed by this customer recently to take care of further plant expansion, another Pritchard Cooling Tower was *specified* for the job.

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the fuel spray; and the timing of injection and ignition allow for margins of error that are commensurate with the requirements for construction, servicing and use of engines."

Acceptable levels of efficiency being all-important in any engine design, the mere elimination of combustion knock does not give efficiency unless other controlling conditions are satisfied. This efficiency may take the form of higher engine power from the same sized plant, or of smaller engine size for a given power output. Engine breathing capacity and factors that control the utilization of the fuel-air combination are the main conditions that affect engine efficiency.

Air swirl must be present in the cylinder during combustion; a properly designed intake port with a shrouded intake valve—(see Fig 3)—gives proper volumetric efficiency along with production of the necessary swirl. Without going into the details that limit the statement, it has been found in general that a suitable swirl-producing system may be substituted for the conventional system without efficiency loss up to piston speeds of 2000 to 2500 ft per min for naturally aspirated engines, and higher speeds for supercharged engines.

Engine Efficiency Comparisons

The TCP engine operation indicates that it possesses the two best characteristics of the Otto cycle and of the diesel cycle, in one operation, that is, the power output of the Otto or gasoline engine, and the fuel economy of the diesel engine.

In Fig. 4 (Fig. 18 in the report), are shown the Indicated Specific Fuel Consumption (ISFC) and the horsepower per hour per pound of air, while superimposed are the three curves of thermal efficiency data. These curves show that the Otto—gasoline engine—cycle operates at high output, high fuel consumption, limited on the lean end by misfiring. The diesel engine shows low fuel consumption, in a lower power output range. The TCP unit covers the range of both and approaches the advantages of both low fuel economy and high output. The high full-load power of the gasoline engine and the high fuel-economy of part-load operation of the diesel are combined in a single operation in the TCP system.

Predictively, it is seen by the authors that the TCP type of engine can show in car performance a minimum of 30 per cent more miles per gallon, and 30 per cent more gallons of engine fuel per crude barrel, than can engines in present-day conventional operation. * * *

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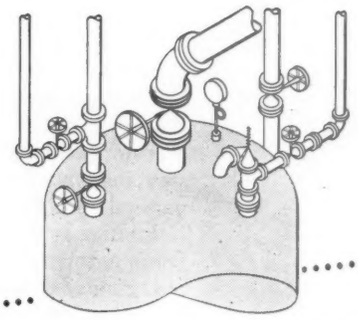

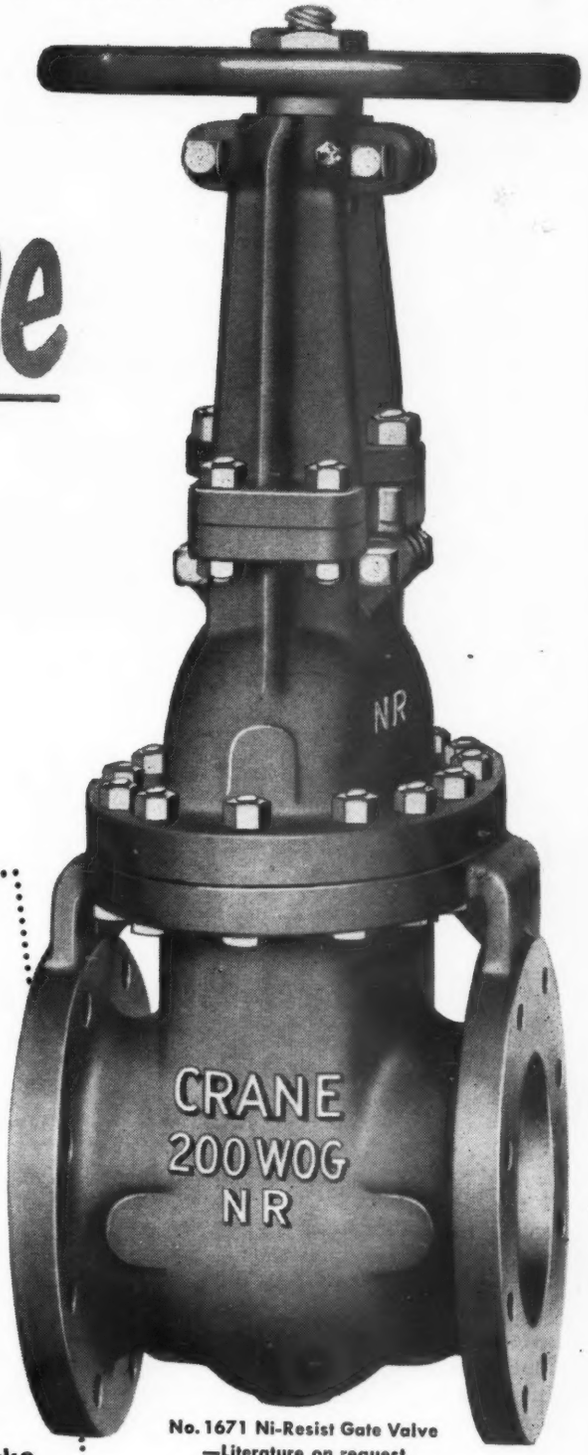

No. 1671 Ni-Resist Gate Valve —Literature on request through your Crane Branch or Crane Wholesaler.

PROBLEM: To find a better replacement for valves that needed repairs every 2 to 3 weeks and failed completely in 3 to 4 months.

WORKING CONDITIONS: Valve exposed constantly to hydrochloric acid vapors at 50 psi, at approximately 280° F., while controlling raw material inlet line to starch converter.

SOLUTION: Crane No. 1671 Ni-Resist Cast Iron Gate Valve with Crane 18-8 Mo Alloy trim.

RESULT: On last inspection, after 19 months' service without one single interruption, Crane Ni-Resist valves were still in very good condition.

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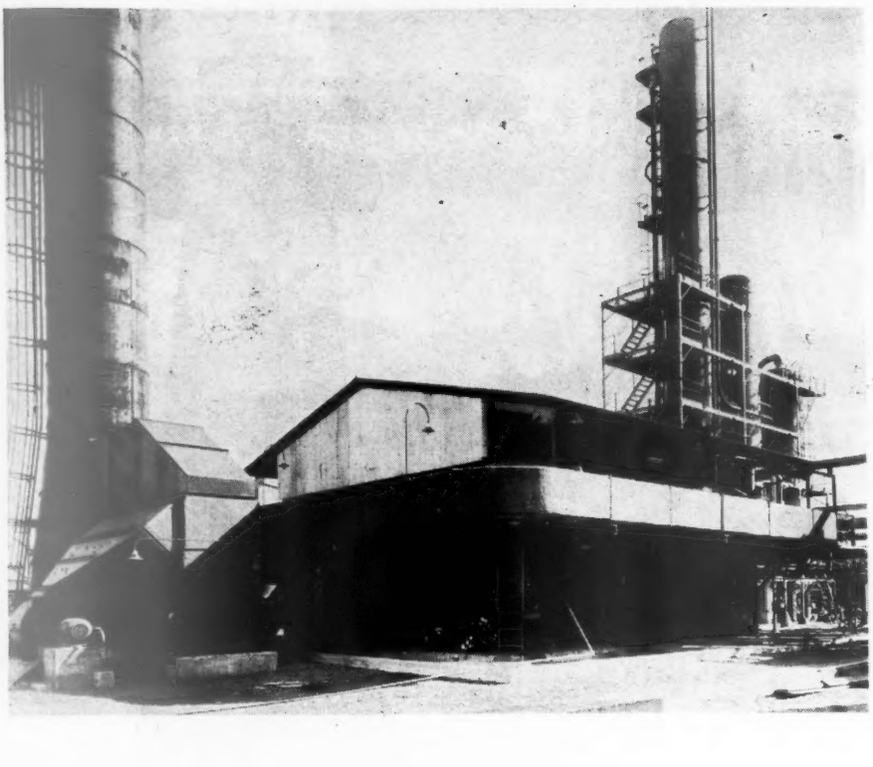


FIG. 1. Insulated flue gas duct from tubestill to stack.

Insulation

Banded-Block Technique

RICHARD L. DAVIS*

THE "banded-block" technique of securing insulation to metal surfaces is widely used in applications where "through-metal" such as wires and bolts is undesirable, and where puncture of the metal surface with screws and bolts must be avoided. By banding mineral wool block insulation to the equipment with metal bands or wires, only the blocks touch the metal surface. In general, block insulation may be applied effectively in this manner to all metal surfaces that can be banded conveniently, whether flat or curved.

Following are the successive steps recommended for applying insulation and finish by the "banded-block" technique.

(1) Clean the metal surface of rust, dirt, etc. with a wire brush .

(2) Brush or trowel an adhesive onto the metal surface to stick blocks temporarily in place prior to banding. Rope-and-spring or rubber girdles may be used as temporary support in place of an adhesive.

(3) Place the insulating blocks of specified thickness in position and tightly butt together. The blocks are pressed downward into the adhesive so that the joints between blocks are sealed and the blocks are secured to the surface. When more than one layer of blocks is required, joints should be staggered and the adhesive applied between layers.

(4) Wrap either No. 16-gage galvanized wires or ½-in. galvanized bands over the block insulation on 6-in. centers. Tighten the wires or bands and secure so as to hold the blocks firmly to the surface of the equipment. Corner beads at the edges of rectangular equipment prevent bands or wires from cutting into the insulation.

(5) Trowel a ½-in. coat of insulating cement over the outside surfaces of the mineral wool blocks.

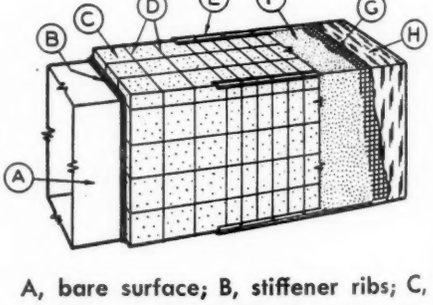
(6) Stretch galvanized wire netting tightly over the insulating cement when completely dried and wire the netting in place.

(7) Trowel a ¼-in. coating of finishing cement or a ⅛-in. layer of asphalt mastic into the wire netting.

Insulation located indoors can be finished with finishing cement, asphalt mastic, or a painted canvas cover. When specified, a 6 or 8-oz canvas jacket is sewn or pasted smoothly in place over the dry insulating cement. When insulation is outdoors, and therefore exposed to moisture or abrasion, asphalt weatherproof mastic is applied as a finish.

In Fig. 1, the flue gas duct leading from a refinery tubestill to its stack was insulated in this manner. The flue gas duct has a total surface area of 700 sq ft and an operating temperature of 620 F. As shown in Fig. 2, corner beads are secured over the

FIG. 2. Details of application of mineral wool insulation.



A, bare surface; B, stiffener ribs; C, mineral wool blocks; D, No. 16-gage galvanized reinforcing wires or ½-in. galvanized bands applied over blocks; E, corner bead secured over blocks at corners with No. 16-gage galvanized wires; F, insulating cement; G, 1-in. galvanized wire netting stretched tightly over insulating cement and wired in place; H, finishing cement or asphaltic finish.

*Secretary, Industrial Mineral Wool Institute, 441 Lexington Avenue, New York 17, New York.

EXCLUSIVE

Block of board insulation—recommended minimum thickness.

Temperature—F	Thickness—inches
Up to 200	1
200 to 400	1½
400 to 500	2
500 to 600	2½
600 to 700	3
700 to 900	3½
900 to 1,100	4
1,100 to 1,300	4½
1,300 to 1,500	5
1,500 to 1,600	5½

FIG. 3

mineral wool blocks at the corners. The mineral wool blocks applied to the duct are 3 in. thick, as recommended in Fig. 3. Also given in the figure (from Commercial Standard CS117-49, "Mineral Wool Insulation for Heated Industrial Equipment") are recommended minimum thicknesses for block or board insulation on metal surfaces at temperatures from below 200 F to 1600 F.

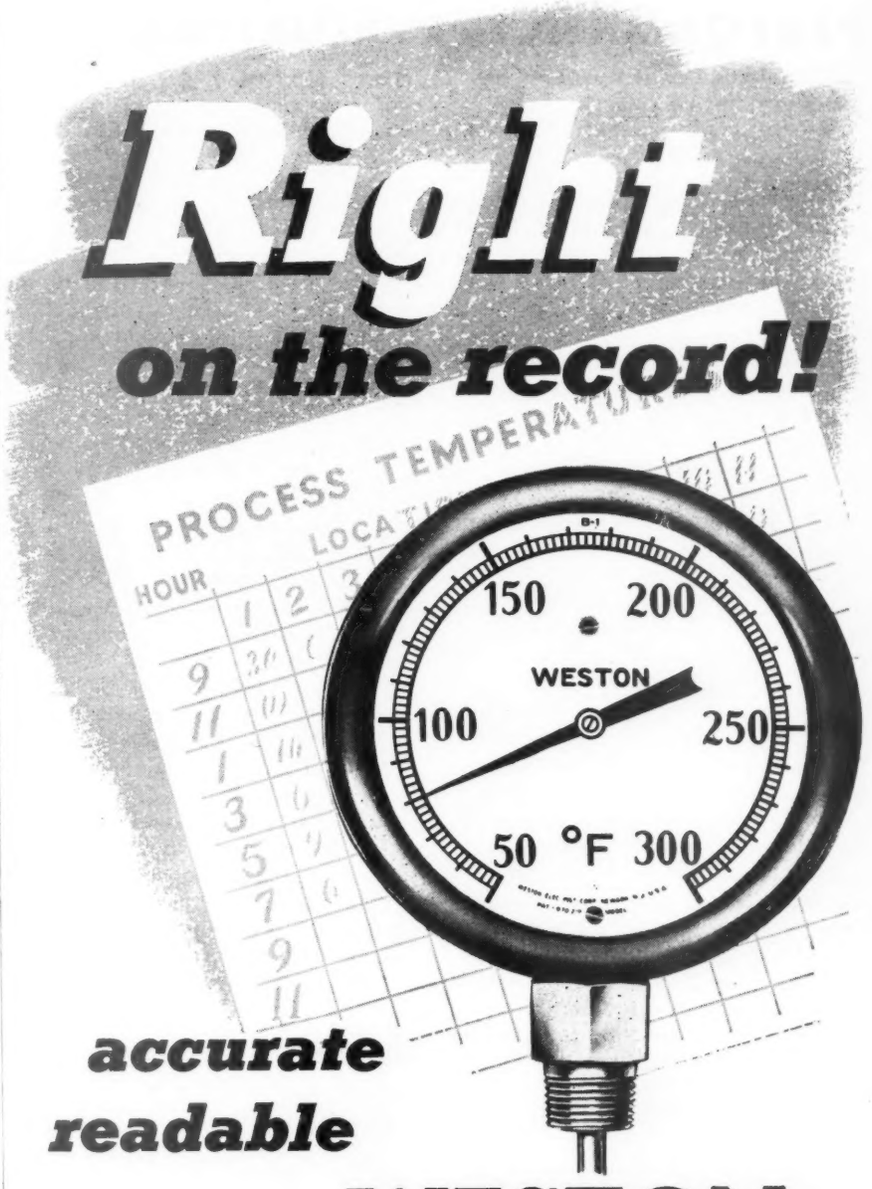
The "banded-block" method of insulation can be used on any equipment that can be banded. It has no limitations as to the type of metal surface (sheet metal, steel, cast iron, etc.), thickness of the metal surface (puncturing is avoided) or location of the surface to be insulated (either indoors or outdoors). Both this insulation technique and the block form of mineral wool are particularly applicable to the insulation of regular, unbroken surfaces of heavy equipment at exposed refining and processing installations. * * *

Shoemaker Elected Head of ACS

Bernard H. Shoemaker of Whiting, Indiana, divisional director of research of the Standard Oil Company (Indiana), has been elected chairman of the American Chemical Society's division of petroleum chemistry. He succeeds A. A. O'Kelly, technical director of the Alox Corporation, Niagara Falls, New York.

F. E. Frey, assistant director of research of the Phillips Petroleum Company, Bartlesville, Oklahoma, was named chairman-elect, and C. G. Kirkbride, vice president of the Houdry Process Corporation, Marcus Hook, Pennsylvania, was re-elected secretary-treasurer.

Dr. Shoemaker was graduated from Hope College in 1926. His graduate work was done at Ohio State University. He joined Standard Oil that year as a research chemist, and was promoted to his present position in 1946.



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PERFORMANCE EVALUATION KEYNOTES SAE MEET

ARCH L. FOSTER*

Improvements in properties of diesel fuel and heavy duty lubricants vied with the "worth" evaluation of improved automotive and aircraft fuels before the annual meeting of the Fuels and Lubricants Activity of the Society of Automotive Engineers that convened in Tulsa November 9 through November 10. This "biggest ever" meeting of this largest group in the SAE organization brings out each year the foremost thinking and research and development activities of the automotive men and their oil refining industry confreres.

For example, the development of the move to apply liquefied petroleum gases to the fuelling of automotive equipment shows some advantages, some drawbacks to this very interesting step, says Leonard Raymond of Socony-Vacuum Oil Company's research department. No fundamental technical difficulties appear to exist in the adaptation of automotive equipment to utilize LPG as motor fuel, although LPG automotive fuel installations cost considerably more than do similar equipment for typical motor fuel, Raymond showed. The lower heat value per gallon for LPG as compared to regular gasoline is offset in engines designed to utilize the higher anti-knock rating of propane and butane as well as mixtures thereof. These light hydrocarbons can be made to show miles-per-gallon economy equal to that of conventional motor fuel.

One of the advantages of this new fuel is that supply will be in excess of demand for several years, at the present rate of increase of consumption. In fact the growth of automotive use of LPG has been erratic, showing a slight volume decline in the last two years. The economics of the operation hinges almost entirely on the price differential between gasoline and LPG; however, reduced maintenance costs with LPG lifts the economics somewhat. Due to the inherently greater safety hazard of any system under pressure for any very volatile fuel the storage, transportation or use of LPG has been prohibited by some municipal and other authorities; yet, with approved and improved equipment and added care in servicing and in operation the LPG safety record should be as good as that of gasoline, Dr. Raymond said.

Of all products tested by the Naval Engineering Experiment Station only organic nitrates and organic peroxides show any important improvement in cetane number of diesel fuels, Messrs. W. E. Robbins, R. R. Audette, and N. E. Reynolds III report. Of 24 nitrates tested in 1.5 per cent concentration, the average cetane number boost when employed in a 39 cetane number diesel fuel was 13.8 numbers. Nine organic peroxides in the same fuel showed an average of 13.0 cetane numbers increase. The individual nitrates showed a boost ranging from 2.1 units for ethylene diglycol nitrate to 21.5 for cyclohexyl nitrate. In two different fuels, 2,2-dinitropropane in 1.5 per cent concentration showed 17 cetane numbers increase.

Among other compounds studied are the organic nitro-carbamates, esters of the nitro derivatives of amino-formic, or carbamic acid (urethane), nitroalkanes. Nitro carbamates, nitro alkanes and organic nitrates show about the same cetane number effect in two per cent concentration in standard specification Navy diesel fuel—meeting Spec. 7-0-2e, mainly straightrun 50 cetane number fuel—that is, 20 numbers increase. In a catalytically cracked, 29 cetane number fuel the nitrocarbamate and the nitrates showed less effectiveness than in the 50 cetane number fuel, giving 12 and 17 numbers boost, respectively, also in 2 per cent concentration.

A different picture is given on the ability of the additive-fuel blend to hold its cetane number increase during extended storage. In 39 cetane number catalytically cracked fuel the peroxides and nitrocarbamates lost little effect during 24 weeks' storage, while the nitroalkane showed almost complete loss of effectiveness in 18 weeks. The nitrate blend tested lost practically all its effect in 6 weeks, showing the poorest storage stability of all additives tested in storage for stability.

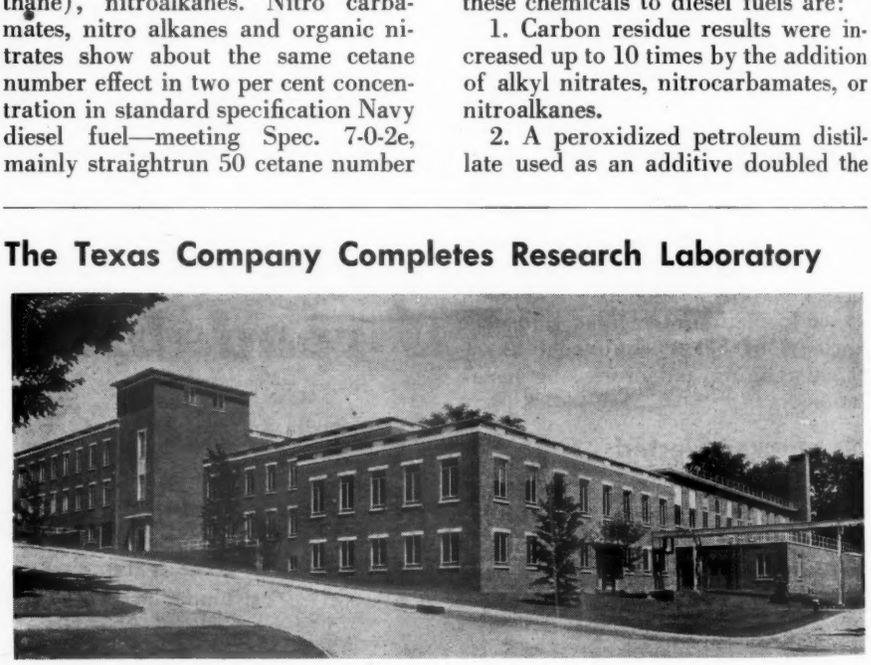
Among other effects of addition of these chemicals to diesel fuels are:

1. Carbon residue results were increased up to 10 times by the addition of alkyl nitrates, nitrocarbamates, or nitroalkanes.

2. A peroxidized petroleum distillate used as an additive doubled the

*Editor, Refining-Gas Processing.

The Texas Company Completes Research Laboratory



Beacon, New York, laboratory of Texaco.

The newest major unit in The Texas Company's research expansion program has been completed at the company's Beacon, New York laboratories, Michael Halpern, Texaco vice president in charge of refining, announced. The brick-faced building affords 55,000 sq ft of added research area and increases by about 40 per cent the facilities of Texaco's main research center, the Beacon Laboratories. It is laid out in 10-ft basic floor-space sections with movable metal partitions in all areas.

The new building is part of Texaco's ten-year research expansion program, which will result in expanded or modernized facilities at all of the company's 28 research and quality control laboratories. It houses engineering and mechanical laboratories, chemical laboratories, and the offices of the supporting services. The chemical section comprises 20 laboratories, which will be devoted to the development of new lubricants, fuels, and chemicals. In the mechanical and engineering section studies of volatility, combustion, and lubrication will be carried on.

carbon residue. In most cases these carbon residues were in excess of that permissible in standard Navy diesel fuels.

3. Some additives are volatile, affecting the flash point adversely in proportion to the degree of volatility.

Tentative tests of additives on ease of starting indicate that about the same results are obtained on doped Fischer-Tropsch fuels as are found with these fuels with no additive, with the same cetane number values. Doped catalytically cracked fuels of about 40 cetane number before blending with the additive showed definitely improved starting properties. Continuation of the study of diesel fuel improver additives is recommended for military purposes by the authors.

The great increase in the number of small personal-type planes now in operation has induced many refiners to study intensively the requirements of these engines for fuels and lubricants and to present on the market products that so far as fuels go, perform satisfactorily in personal plane engines with the occasional exception of detonation, said W. V. Hanley of Standard Oil Company of California. Maintaining clean engine cylinders is most important in maintaining original octane requirements in these engines, Hanley has found. One engine operating on a highly detergent crankcase oil for 334 hours showed an increase in octane requirement of 6 numbers. Another engine using an experimental non-deposit-forming oil showed no increase in anti-knock requirement with extended operation. Continued detonation does not cause engine failure, but may cause excessive wear in the combustion chamber and may cause high ring wear also, forcing early engine overhaul. Aviation engines requiring 80 octane number fuel for cruising should have 87 octane number fuel, by the F-4 method for take-off (rich mixture take-off).

Uncompounded lubricating oils are not satisfactory in this type of engine, Hanley stated. Very highly compounded detergent oils can cause severe preignition, which can cause engine failure by piston melting in a few minutes' time in the entire absence of detonation. New type additive oils are being developed now, which will not cause preignition and will provide cleaner engines with longer periods between overhauls.

The widely varied type of experimental work reported on at this meeting indicates conclusively the extreme complexity of the programs carried out by the various automotive and oil refining companies in efforts to meet demands for better and better products. * * *

Houston ISA Group Holds Committee Meet

At a meeting of the Houston section committee of the Instrument Society of America recently plans were discussed for the sixth national Instrument Conference and Exhibit to be held in the Sam Houston Coliseum, September 10-14, 1951.

Present were those shown in the photo: Seated, Dale Mattix, Cities Service Corporation, Lake Charles, Louisiana; C. R. Miller, General Tire and Rubber, Baytown, Texas; M. J. O'Neal, Shell Oil, Houston, Texas; C. W. Bates, Humble Oil and Refining, Baytown; Prof. G. L. Farrar, Department of Chemical Engineering, A & M College of Texas; M. K. Anderson, Carbide and Carbon Chemical Company, Texas City, Texas; W. H. Fortney, Humble Oil and Refining, Baytown; Paul H. Buehner, convention manager, Houston Chamber of Commerce. Standing: W. B. Rawson, vice president, Maintenance Engineering Corporation, Houston; A. Costa, Westcott and Greis, Houston, Texas; R. E. Hanson, Leeds and Northrup, Houston, Texas; E. E. Kleir, Foxboro Company, Houston, Texas; R. L. Nichols, Magnolia Petroleum, Beaumont, Texas; C. L. Garner, Garner Instrument, San Antonio, Texas; L. C. Books, Shell Oil, Houston; I. K. Farley, Brown Instrument Division, Houston; Richard Rimbach, executive secretary, ISA, Pittsburgh, Pa.

Chile to Get First Processing Plant

Hudson Engineering Corporation of Houston, Texas, has been engaged by the Chilean government to build a $3,000,000 oil and gas processing plant to be erected south of the Straits of Magellan on the island of Tierra del Fuego almost 80 miles south of Punta Arenas.

The plant will process gas and crude oil from the Spring Hill field, the first oil or gas field developed in Chile. The discovery well came in in December 1945. The field now has 40 wells.

The plant will process 30,000,000 cu ft of gas and 6000 bbl of crude oil daily. Butane and heavier hydrocarbons will be extracted from the gas, and the stripped gas will be returned to the reservoir to minimize pressure decline. The light fractions which, through evaporation, would cause crude oil loss during tanker transportation will be stripped from the crude oil, and the stable liquid hydrocarbons extracted from the gas will be blended with the stripped crude. It is expected that the plant will be placed in operation in June 1951.

Atlantic to Increase Production of Detergents

The Atlantic Refining Company plans the immediate expansion of its facilities for manufacturing synthetic detergents, Robert H. Colley, president, announced. Additional manufacturing equipment will be installed in both the Philadelphia refinery and the Port Arthur, Texas, refinery at an estimated cost of between three million and four million dollars. The new facilities are planned to increase the output now being manufactured as well as to manufacture new products.

Carter Sells Refinery to Berry

Carter Oil Company recently sold its Cut Bank, Montana, refinery to W. C. Berry, independent operator of Tulsa, Oklahoma. Operations were shut down October 1. The Carter plant has a crude capacity of 3500 bbl per day and has been running at that rate on northern Montana crude. It is reported that Berry plans to dismantle the plant and move it to Superior, Wisconsin where it will operate on Canadian crude.

NEWS

Brazil Refinery Planned

A new refinery is being built in Brazil at Cubatao in the Province of Sao Paolo. It is designed to handle 45,000 bbl per day of crude, and produce 118 million litres of aviation petrol, 1000 million litres of ordinary petrol, 234 million of kerosine, 44,000 tons of gas (propane), 203,000 tons of diesel oil, and 570,000 tons of fuel oil annually. The new refinery is expected to be in operation by 1953.

Shell Offers Courses For Training Employees

A training program for the employees of the Shell Chemical Corporation's synthetic rubber plant in Torrance, California, which is scheduled to be in production by mid-December, was inaugurated at Harbor Junior College recently. The training program, planned in cooperation with Shell Chemical Corporation executives, is providing instruction in such subjects as physics, chemistry, instrumentation, and refining processes for the employees, with members of the local college teaching staff serving as instructors.

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Stainless Steel Gate Valves

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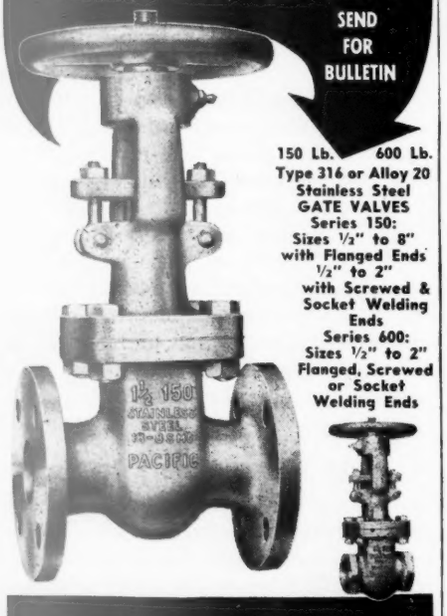

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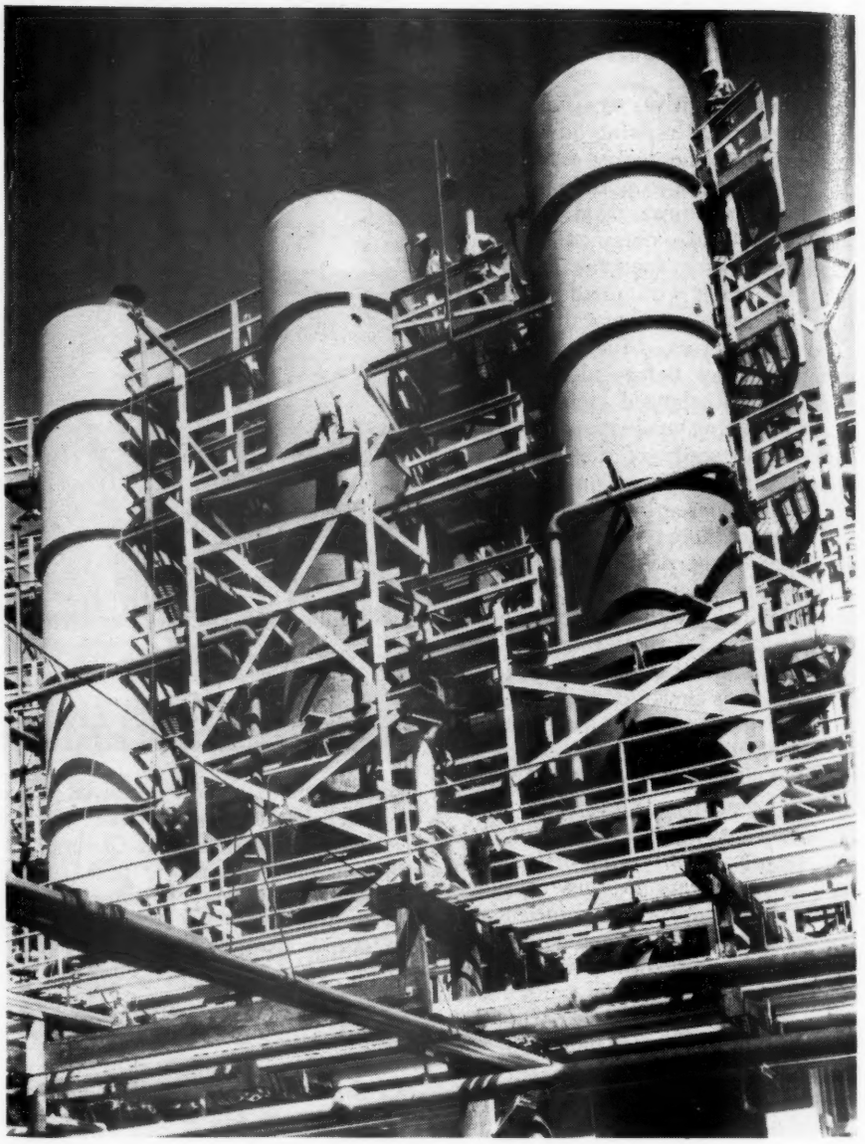


Plant reactivated by Naugatuck Chemical division, United States Rubber Company, for Office of Rubber Reserve began production 20 days ahead of schedule.

Synthetic Rubber Plant Opened Ahead of Schedule

The first of the nation's all-purpose synthetic rubber plants to be reactivated under the government's expanded rubber program has begun production 20 days ahead of schedule. The huge plant, designed with a production capacity of 60,000 long tons a year, has been modernized by engineers of United States Rubber Company so that it will produce more than 72,000 long tons a year when operating at peak load. Peak capacity of 6000 long tons per month or 72,000 long tons a year is expected to be reached by December 1. This will mean a boost of 17.5 per cent above current industry production. The rubber will be used to meet the nation's skyrocketing civilian and military demands for tires and other rubber products.

Continental Contracts for TCC Unit; Expands Capacity

Continental Oil Company has awarded a contract to E. B. Badger and Sons, Boston, for the design and construction of processing equipment which is part of the $10,000,000 construction program that will double the crude oil charging capacity of Continental's Lake Charles, Louisiana, refinery.

The expansion program, which will increase the refinery crude capacity to 25,000 bbl daily, will include the installation of a thermofor catalytic cracking unit and additional auxiliary equipment for the production of high octane gasoline. The enlarged refinery will manufacture, in addition to a full line of domestic gasolines and heating oils, high octane aviation gasoline for the armed forces. It is scheduled for completion in the early part of 1952.

Another Important Instrumentation Development by Beckman . . .

- ✱Greater Compactness
- ✱Higher Accuracy
- ✱Lower Sample Consumption
- ✱Maximum Convenience

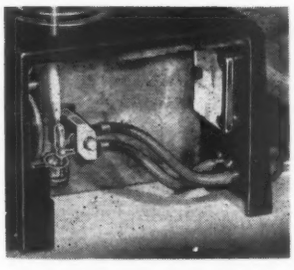
THE NEW BECKMAN Flame Photometry Attachment

FOR BECKMAN "DU" SPECTROPHOTOMETERS

Flame spectrophotometric methods have become increasingly important in modern analytical procedures, and every day new applications are being developed for these simple, convenient methods.

To meet the steadily growing interest in flame spectrophotometric methods, Beckman development engineers have designed a new Flame Photometry Attachment—an instrument so far advanced over similar equipment heretofore available that it sets entirely new standards of compactness, convenience and accuracy. It permits complete analyses to be made on even extremely small samples of test solution.

The new Flame Photometry Attachment is designed for use with the Beckman "DU" Spectrophotometer, thus combining the unusually high accuracy and resolution of this well-known instrument with the conveniences of flame spectrophotometric methods. The flame is supplied by standard oxy-hydrogen or oxy-acetylene equipment—and no water or air is necessary, either for cooling or for operation of the instrument.



An important feature is the atomizer-burner, which is much smaller and more compact than previous designs, and also simpler and more trouble-free. The atomizer-burner is made of Pyrex with a straight, noble-metal atomizing tube that discharges directly into the flame. The straight, large-diameter atomizing tube assures a steady flow of sample, eliminating drifts, and the atomizer will spray even cloudy or highly concentrated solutions indefinitely without clogging.

Other important features of this new Beckman development are outlined at right. Best of all, this new instrument is available at a new low price for equipment of this quality. Your nearest authorized Beckman Instrument dealer will gladly supply full details—or write direct!

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Illustration at right shows atomizer-burner actual size.

Outstanding Features of the New Beckman Flame Photometry Attachment

- Sample beaker is supported in a unique mechanism that swings the beaker outside the case for easy filling, or swings it back into position below the burner tube. Further, as the beaker is raised into position below the burner, it automatically tips so that sample solution is drawn from lowest point in beaker. Thus, complete analyses can be made with even extremely small samples.
- The atomizer requires only about 2 ml of sample solution per minute, and a sample of 1 to 3 ml is ample for determination of several constituents.
- Fuel consumption is very low—about 5 cu. ft./hr. for acetylene, 8 cu. ft./hr. for oxygen, 20 cu. ft./hr. for hydrogen.
- The hot flame, coupled with the high resolution of the "DU" Spectrophotometer, permits unusually narrow band widths to be used—less than 10 millimicrons for most determinations. Accuracies of 0.5% or better are obtainable.
- Sample concentration is unimportant (provided it is above the lower detectable limit) permitting maximum versatility and convenience in making analyses.
- Although the sensitivity of most elements is improved when the elements are in water solution, nonaqueous solutions are as easily handled as water. Even combustible solvents can be used—and in fact, organic solvents frequently increase sensitivity of the readings.
- The atomizer-burner, sample-positioning device, focusing mirror and adjustments are all unitized into a compact, cast-metal housing. All necessary regulators and gauges (except standard regulators on fuel and oxygen tanks) are conveniently mounted on a separate control panel.

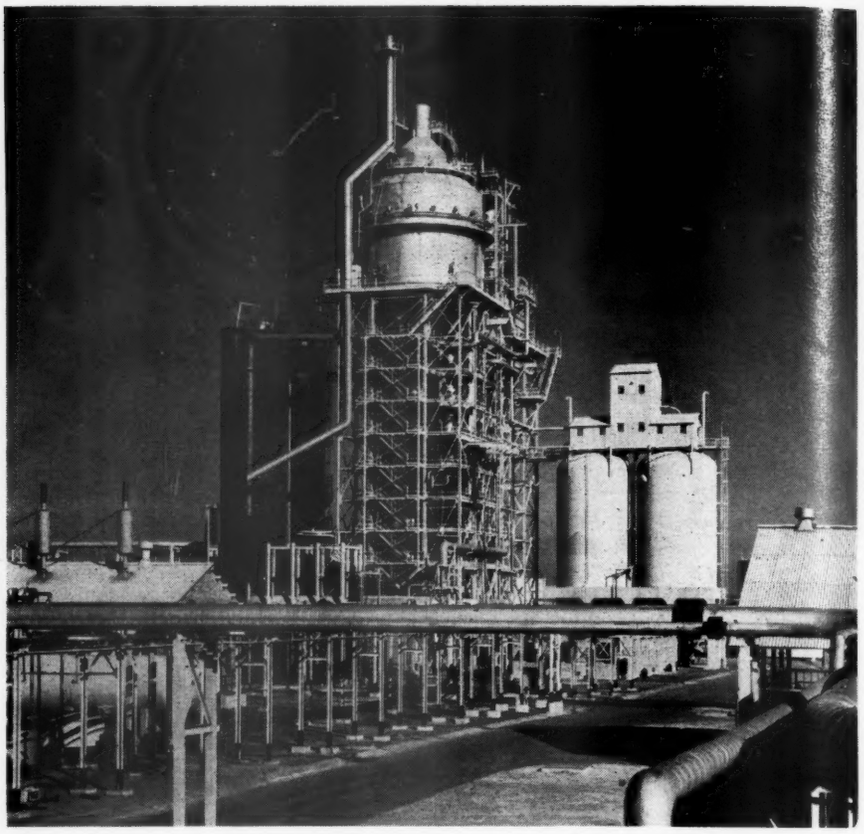
Write for complete details on this important new Beckman advancement!

Sunray Cat-Cracker Sets World Record

The world's record for continuous operation of a fluid catalytic gasoline cracking unit was broken at Duncan, Oklahoma on November 8 with the announcement that Sunray Oil Corporation's 25,000-bbl daily capacity unit at Sunray Village had run 611 days—breaking the former continuous operations record of 610½ days set at the Tide Water Associated Oil Company's Avon, California refinery in 1948.

The giant Sunray refinery unit at Duncan will continue to run without shutdown as long as its present high rate of efficiency is maintained according to announcement by Floyd L. Martin, Sunray's vice president directing the refinery division.

The Sunray "cat" is operated under the direct supervision of R. L. (Dick) Johnson, manager of the refinery, and Aultman T. Smith, assistant plant superintendent, who is in charge of the unit's physical operations. Johnson is a longtime Sunray employee, his service dating from 1928. He was formerly manager of the company's refineries at Allen, Oklahoma, and Santa Maria, California. Smith joined Sunray on acquisition of the Duncan plant in 1947, having formerly been associated with the Cosden Oil Corporation, and Associated Refiners, Inc. R. C. (Rube) Underwood, plant superintendent, was also formerly with the Associated Refiners, operating the plant during World War II.



Duncan, Oklahoma, gasoline cracking unit of Sunray.

Four head operators responsible for smooth operation of the cracking unit during work shifts are R. H. Coates, C. W. Dean, Buster Ludwick, and Paul Haggard. The unit's "board men" responsible for noting variables in unit operation for top efficiency are E. H. Chadwick, Clay Gamblin, R. U. Barnes, and V. R. Wilson. Fractionator operators who watch the operations of all pumps and the large turbo blowers, etc., include M. V. Buck, C. D. Green, O. E. Sirmans, and P. C. Thomas. The versatile first class helpers watching catalyst flow, recording instrument readings, and catching samples for laboratory runs, etc., include C. W. McCord, R. D. Stokes, J. D. Rickie, L. O. Bishop, H. M. Allison, R. W. Smith, and O. W. Teague.

Glenn Slocum, instrument foreman, and Instrument Men B. J. Carruth, O. W. Buck, Harry Scoville, L. M. Owen, C. C. Whetsell, and Fred Carpenter are another group primarily responsible for the "cat" performance.

Sunray's Duncan refinery was acquired by the company in 1947. It was one of the three largest built by the government for World War II aviation gasoline production. The unit was remodeled for domestic gasoline production at that time and has been on stream since March 7, 1949, at 11:00 a.m., a total of 14,598 hours.

The giant refinery unit has produced more than 3,116,000 bbl of gasoline since that time. Liquid recovery is 97.1 per cent with all loss being recovered as fuel gas, supplying 44 per cent of the refinery's fuel gas requirements.

Since the record run was begun in March of 1949 about 6,110,000 bbl of raw charge has been processed to the unit at an average daily charge rate of approximately 10,000 bbl. The on-stream efficiency of the Sunray refinery is calculated at 99.7 per cent.

Approximately 80 per cent of the more than 15,700,000 bbl of crude oil processed to provide the gas-oil charge for the cat-cracker was processed at Sunray's Duncan plant.

Indicative of the tremendous production capacity and efficiency of Sunray's big cat cracker at Sunray Village is the fact that during the record-breaking 611 days, the blower serving the unit handled enough air to completely fill 6,293,000 average-size six-room houses. If the largest blower wheel operating in this equipment were mounted on an automobile and run, the average speed of the auto would be 409 miles per hour, and during the 611 day run would have traveled around the world 240 times.

REPAIR LEAKS
QUICKLY—PERMANENTLY

SKINNER-SEAL PIPE JOINT CLAMPS stop leaks at joints. Put on under pressure—without interruption of service. Quick, simple, lasting repair. Sizes 1/2" to 24" incl. in stock.

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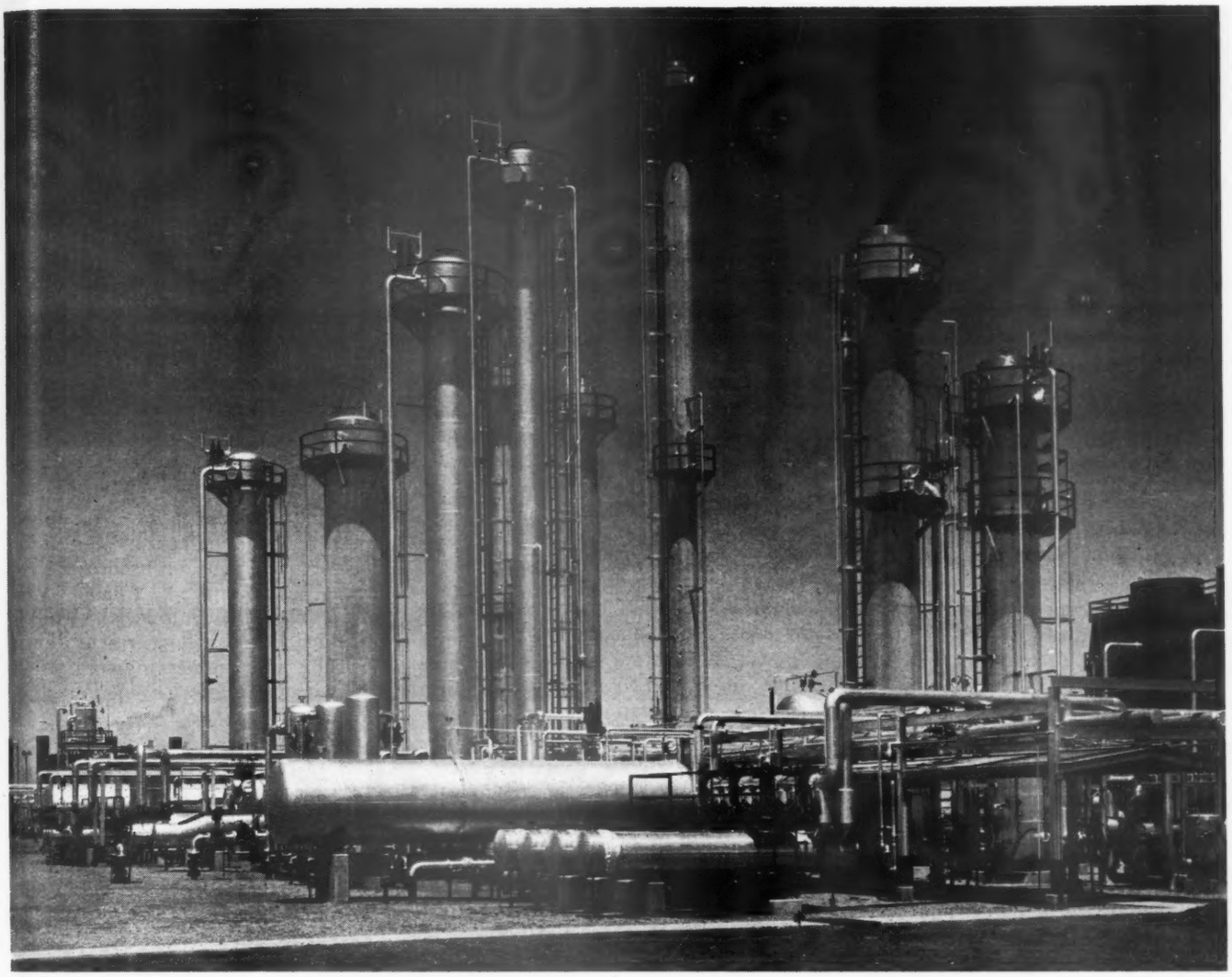


Towers at Humble's new Jourdanton gasoline plant are part of the equipment for extracting butane, propane, and natural gasoline from casinghead gas produced in fine nearby oil fields.

Humble Completes Jourdanton Gasoline Plant

The opening of Humble Oil and Refining Company's new natural gasoline plant at Jourdanton, south of San Antonio, Texas, completed the company's $33,000,000 gas conservation program as originally planned at the end of World War II, according to an article in the current issue of *The Humble Way*, company magazine.

With the completion of the Jourdanton plant, Humble is currently conserving about 85 per cent of all the casinghead gas it produces from its oil wells. The conservation program, according to the article, included 32 projects built since 1945 with a capacity of 300,000,000 cu ft of Humble's casinghead gas daily. In all, Humble has invested about $42,000,000 in facilities to handle 450,000,000 cu ft of casinghead gas daily.

The new Jourdanton plant has a total capacity of 26,000,000 cu ft of gas each day—enough to supply 120,000 homes. Gas, which was formerly flared, is gathered from the Charlotte, West Charlotte, Imogene, East Imogene, and Jourdanton oil fields in Atascosa County. Liquid components are extracted and the dry gas is sold to a transporting company for industrial and home consumption in cities and towns of the area.

Butane and propane are sold to distributors for rural consumers in Southwest Texas area.

ECA Plans Dunkirk Plant

An official spokesman of the Economic Cooperation Administration has announced that a modernized and rebuilt oil refinery is being planned for the Dunkirk area on the French coast. It will be partially financed by Marshall Plan money.

ECA also revealed that it has given approval for funds to help pay for a new refinery at Lingen, Germany and cracking equipment for a refinery at Morto Margharea, Italy.

Derby Oil Company Plans Refinery Expansion

The Derby Oil Company of Wichita, Kansas, has awarded a contract for the construction of a new Socony Thermofor catalytic cracking unit, a new Universal Oil Products polymerization unit and a gas concentration plant. The new equipment is of designed capacity for increasing future crude runs of the refinery up to 15,000 bbl per day. The Thermofor catalytic cracking unit is of designed capacity to process 7500 bbl of virgin gas oil per day. The catalytic polymerization unit and the gas plant are also sized for future increased crude capacity.

The basic process design is being furnished by Socony Vacuum Oil Company, Universal Oil Products Company, and The Fluor Corporation, Ltd. Fluor will handle engineering and construction.

The total expansion program will run in excess of $2,000,000, and is to be in operation in 11 months.

—PERSONALS—

▸ **Robert C. Hills, Thomas R. Vaughan,** and **Richard C. Wells** have been elected vice presidents of Freeport Sulphur Company by the board of directors.

Hills began with Freeport in 1934 as a chemist at the company's sulfur operations in Louisiana. During the war he served as manager of the metallurgical plant in Cuba of Nicaro Nickel Company, a subsidiary of Freeport. He became assistant to the president in 1946 and director of development at the beginning of this year. Vaughan, an attorney, joined Freeport in 1942 and became assistant secretary later that year. He has been an assistant vice president since 1947. Wells came to Freeport in 1939. He was made assistant treasurer in 1942 and in 1946 became controller in which position he continues.

▸ **Daniel P. Barnard IV,** research coordinator for Standard Oil Company (Indiana) will receive the 1949 Horning Memorial Award at the January, 1951 annual meeting of the Society of Automotive Engineers in Detroit, Michigan. He will be awarded in recognition of distinguished service in the field of mutual adaptation of fuels and engines. He is president and a director of the Coordinating Research Council, and also chairman of the automotive research committee of the American Petroleum Institute, division of refining.

▸ **Michael A. Remondino** was appointed technical representative covering the Eastern sales region and Canada for the Ethyl Corporation research laboratories in Detroit, Michigan. He succeeds **Charles B. Kass** who has been named to the staff of the laboratories' newly-created information division. For the past year, Remondino has served as a research engineer in the commercial engine and fleet section of technical service, assisting in liaison activities between the manufacturers of commercial engines and vehicles and the petroleum industry.

▸ **Charles Leet,** assistant general manager of the Baton Rouge, Louisiana, refinery for Esso Standard Oil Company, was recently elected a director of Interstate Oil Pipe Line Company. He fills the post vacated by the resignation of **Cecil Morgan,** vice president of Esso Standard in charge of Louisiana manufacturing operations and crude oil purchasing.

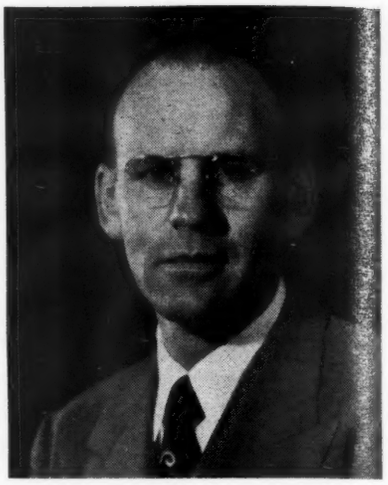
▸ **Howard Cooper** has been elected president of the National Lubricating Grease Institute. His election was announced at the annual meeting of the NLGI in Chicago, Illinois. Manager of technical service for the Sinclair Refining Company, Cooper succeeds A. J. Daniel, the retiring president. A member of the organization's board of directors since 1945, he was elected vice president of NLGI at last year's annual meeting. Cooper entered the petroleum industry as lubrication engineer for The Texas Company immediately following his graduation from the Armour Institute of Technology (now Illinois Institute of Technology) where he obtained a B.S. degree in mechanical engineering. He became associated with the Sinclair Refining Company in 1923 and since that time has held the positions of lubrication engineer, assistant manager of lubricating sales, chief lubrication engineer and currently, manager of technical service.

Also unanimously elected to assume the vice presidency of the NLGI was **G. E. Merkle,** vice president of Fiske Brothers Refining Company, Newark, New Jersey. **C. B. Karns,** Esso Standard Oil Company of Pittsburgh, Pennsylvania was unanimously re-elected treasurer of the association.

The following six directors were unanimously elected for a three year term: **W. W. Albright, Howard Cooper, C. B. Karns, P. V. Keyser, Jr., G. E. Merkle,** and **W. H. Oldacre. Harry F. Bennetts,** the present executice secretary, will continue to serve in the same capacity.

▸ **Cecil E. Rhodes,** has been appointed special projects district engineer at the Asphalt Institute, with offices in Denver, Colorado. He succeeds **Walter F. Winters,** recently promoted to the post of chief engineer. Rhodes will be in charge of the Institute's special studies dealing with asphalt uses in developing the Reclamation Program, including canal, reservoir and pond linings, dam facings, and erosion control.

▸ **William H. Dyer,** engineer at Hobbs, New Mexico, Warren Petroleum Corporation, was recently transferred to Maysville, Oklahoma as plant chemist engaged in plant operations. **E. F. Jernigan,** chemist at Maysville was transferred to the Tulsa, Oklahoma liquefied-petroleum-gas division.



Harry J. Burns

▸ **Harry J. Burns** has been appointed senior resident engineer in Mexico for the Perco Division of Phillips Petroleum Company, K. S. Adams, company president, announced. In this position, Burns will represent Perco licensing and engineering services in the various refineries of Petroleos Mexicanos.

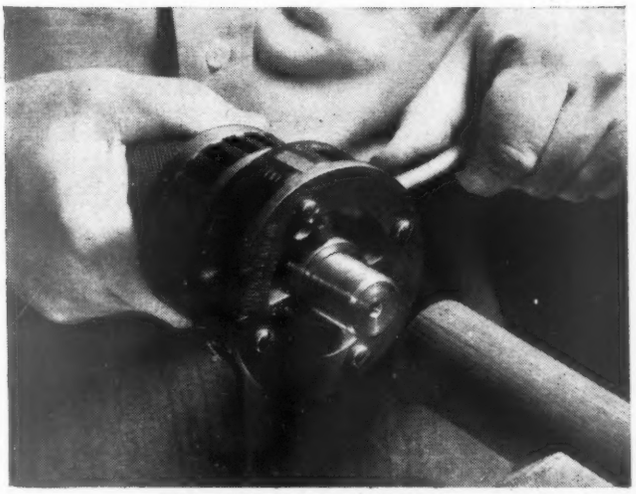
Burns received his degree from St. Mary's College, St. Marys, Kansas, in 1931. He joined the refining department of Phillips in 1932, and progressed to superintendent of manufacturing at the Phillips Kansas City, Kansas, refinery. In September 1945, Burns transferred to Mexico City as Phillips operation supervisor under the Phillips petroleum supervisory contract with the Mexican Government.

▸ **Joe H. Bell, Jr.** has joined Tide Water Associated Oil Company as engineer at the Drumright, Oklahoma refinery. He is a recent graduate of Oklahoma A. & M. College.

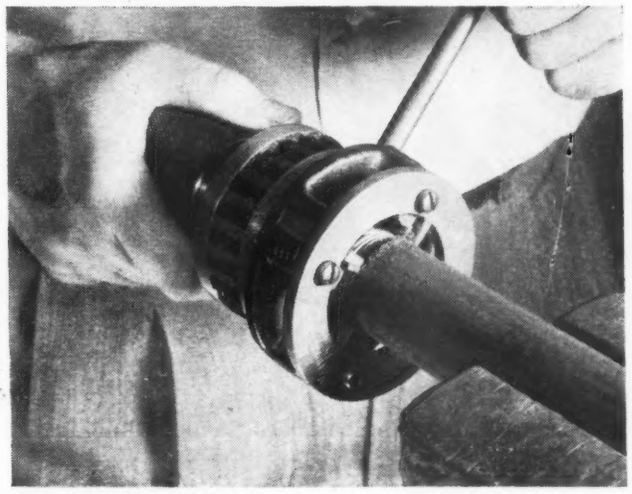
▸ **O. R. Leonard** has been named supervisor of the newly created chemical testing group at Esso Standard Oil Company's Baton Rouge, Louisiana refinery, and **H. E. Westbrook** has been named supervisor of the analytical group. **C. K. Heltzel** has been assigned to the analytical group as chemist to handle special analytical problems, and **G. F. Ullrich,** formerly of petroleum technical service, has been transferred to the laboratory to carry out special studies in the planning of laboratory work.

▸ **W. L. (Lee) Spencer** has been appointed manager of refinery sales for Union Oil Company of California. Spencer will be in charge of all Union's marketing activities outside of its domestic territory on the Pacific Coast, exclusive of foreign sales and will report directly to Roy Linden, vice president and sales manager.

Get this new HAND threader for "Karbate" Pipe BRAND



TOOL ABOUT TO BE INSERTED IN "KARBATE" PIPE.



TOOL CUTTING THREADS.

TOOL REMOVED. NOTE CLEAN, SHARP THREADS.

WRITE to National Carbon today and ask us for complete information on the new hand-threading tool for use with "Karbate" impervious graphite pipe. The new tool eliminates the need for an expensive lathe and is easy to carry to any job site. It cuts "Karbate" impervious graphite like wood . . . delivers clean, sharp threads . . . is inexpensive to buy. If you like, we'll have a salesman call and demonstrate the tool to you in person, without cost or obligation.

MORE THAN DOUBLE THE USABLE LIGHT! . . .

The biggest news since the invention of flashlights—the brand new "Eveready" No. 1050 flashlight battery—gives more than double the usable brilliant white light for critical uses than any other flashlight battery we have ever made.

NO METAL CAN TO LEAK OR CORRODE!

The terms "Karbate" and "Eveready" are registered trade-marks of

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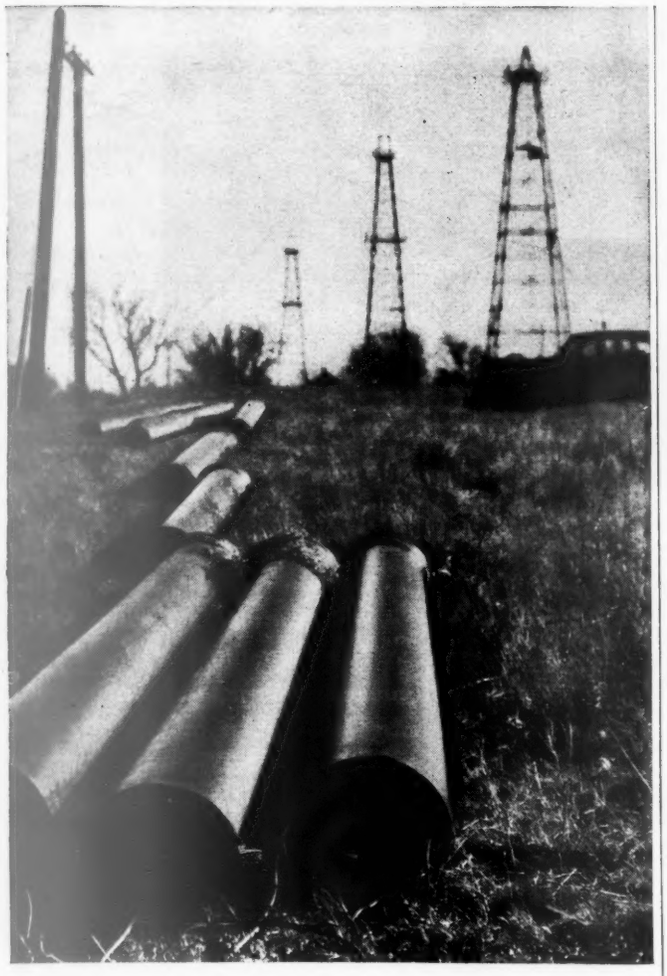


AN OLDTIME RECIPE FOR
LONG-LIVED PIPE LINES

A recipe that waterworks and gas distribution engineers have used for over a century is: *specify cast iron pipe.* Refinery engineers have used it, too—with good success—for run-down, water and gasoline lines—for fire protection systems—salt water disposal—condenser and cooling coils.

No other pipe, at reasonable first cost, offers comparable resistance to both interior and exterior corrosion. No other pipe, in its price range, is as economical in the end. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints. Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

CAST IRON PIPE
FOR LONG LIFE AND ECONOMY

Butadiene Plant Reopened at Houston, Texas

First of the nation's standby petroleum butadiene plants to be reactivated under the extended rubber program of the Office of Rubber Reserve, Reconstruction Finance Corporation, has begun production at Houston, Texas. Sinclair Rubber Inc. operates the plant. Except for the power unit, this plant has been in standby since the latter part of 1947. Since the reactivation was requested by Rubber Reserve in July, this petroleum butadiene plant has been completely renovated, including fractionating towers, tanks, pumps, turbines, motors, valves and piping.

When operating at proven capacity, the annual production of butadiene will be approximately 75,000 tons, which will be delivered to the adjacent copolymer plant operated by the Goodyear Synthetic Rubber Corporation. Sinclair Rubber Inc. officials responsible for the operation of the plant are: J. O'C. Brown, manager; C. W. Hardell, superintendent, and R. C. Woerner, assistant superintendent.

An important factor in placing the plant in operation, was the skill of the personnel employed. About 50 per cent of the 400 employees required for operations are former employees who operated the plant during World War II.

Taylor to Install Platforming Unit

Taylor Refining Company, Taylor, Texas and Mayfair Minerals, Inc., McAllen, Texas have announced plans to install a U.O.P. Platforming Unit in their jointly owned refinery at Port Isabel, Texas.

Construction of the 4000-bbl per day unit, which is being designed and engineered by Universal Oil Products Company, Chicago, will get under way as soon as possible, according to G. L. Rowsey, president of Taylor Refining Company and V. E. Cook, president of Mayfair Minerals, Inc.

The Platforming Unit will be designed to process a mixture of naphthas produced from coastal crudes and recycle distillates. The addition of the Platformer to the Port Isabel, Texas refinery is part of a modernization and expansion program and will permit the production of high octane gasoline.

Catalytic Refining at High Efficiency Level

Catalytic refining of petroleum to yield high-grade gasoline is at a higher point of efficiency than ever before as the result of new developments in the process by the Socony-Vacuum Oil Company, Inc., according to the current issue of "The Flying Red Horse," employees' publication. Catalytic refining utilizes a chemical procedure to reshuffle the hydrocarbon molecules that comprise petroleum. It consists of passing pre-heated charge stock through a constantly-moving catalyst bed. Socony-Vacuum pioneered the process 14 years ago.

Until the new type unit was introduced recently the catalyst in the form of beads was raised by bucket elevators after regeneration of the catalyst to remove carbon that it accumulated during the "cracking" process. Now the catalyst is raised by compressed air to a height of 200 ft to the top of each unit.

The company publication article discloses that eight of the new "gas-lift" units are being built in Socony-Vacuum refineries to replace previous types which used fixed beds of catalyst. Their combined capacity will be 40,000 (42-gallon) barrels more per day than their predecessors. Four are being built under licenses to other American oil companies. Two are being erected also in Socony-Vacuum refineries abroad and three more have been licensed to other European refiners.

Socony-Vacuum also has designed its new catalytic cracking units in smaller sizes which can be prefabricated for erection at refineries unable to afford the larger, standard-size units, the magazine article points out.

Service Pipe Line's New Building

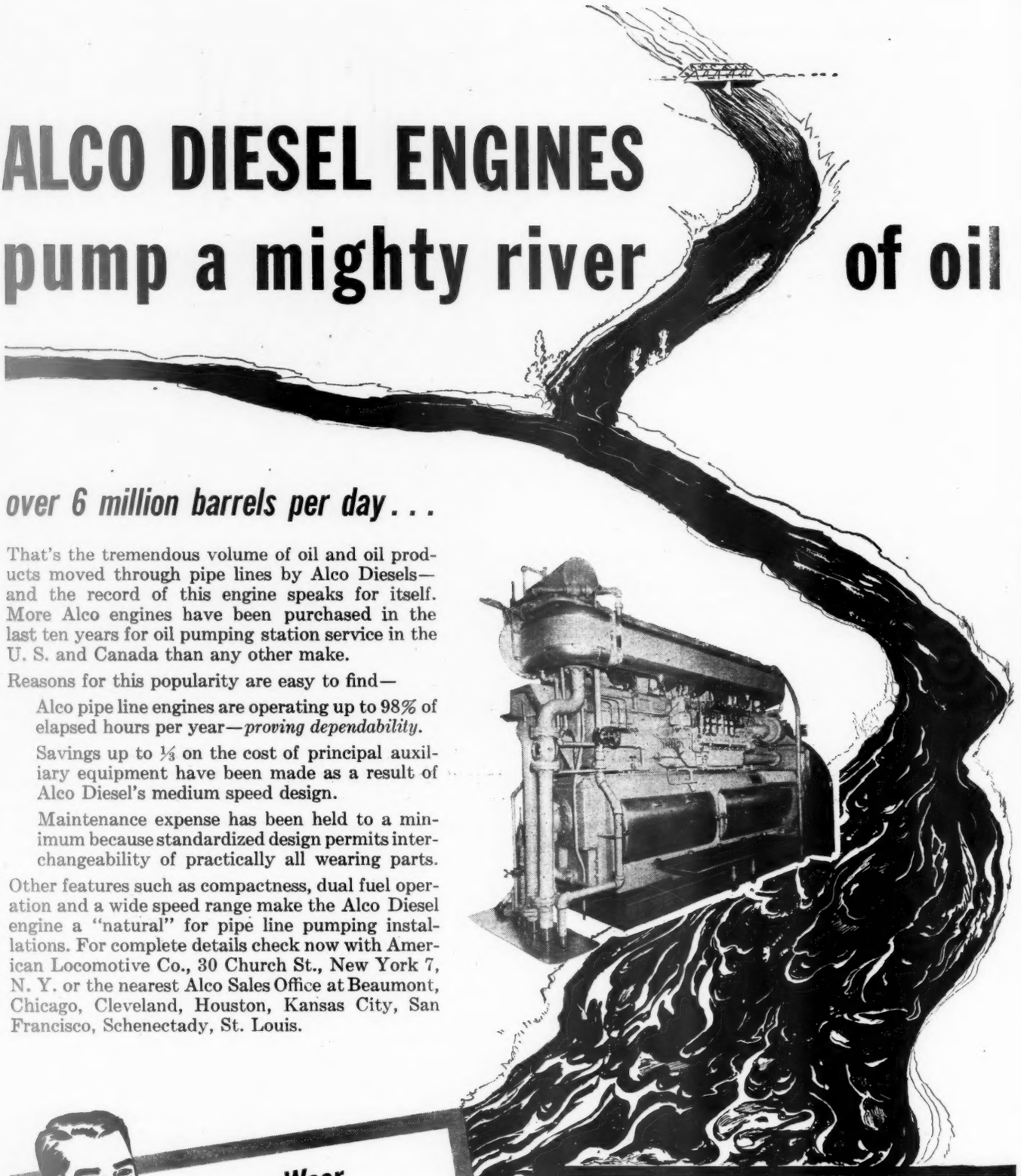
THE SERVICE PIPE LINE COMPANY has opened a new office building in Tulsa, Oklahoma, the only pipe line company that can boast of an entire building for its exclusive use. The building is headquarters for a crude oil pipe line system that operates 11,450 miles of line in ten states and employs 2600 people. It transports production from 24,000 wells to which it is connected and from approximately 4000 additional wells reached by connecting carriers. The oil is from New Mexico, Texas, Oklahoma, Kansas, Colorado, Wyoming, and Nebraska and movement is to 12 refineries directly and to some 27 more through connecting carriers.

The building's features are distinctive, to say the least, combining both beauty and usefulness. Marble is used extensively throughout the corridors and color dynamics have been applied to create restful and pleasant working conditions. The exterior is buff brick with a green terra cotta trim. Among the structural advancements are movable steel walls between offices on the first five of the building's six floors, and controlled air conditioning and heating facilities in individual offices. Many of the innovations were prompted by the thought of comfort for the 500 Tulsa employees. Air conditioning, special lighting and sound-proofing, a coffee lounge, and a beautiful conference room where special training courses and meetings are held are among these.

Service Pipe Line Company was known as the Stanolind Pipe Line Company until its name was changed earlier in the year to eliminate confusion resulting from the fact that there are several other companies in the oil industry bearing the name Stanolind. The history of the company, however, goes back 34 years through three other name changes. The Sinclair-Cudahy Pipe Line Company was organized in April, 1916, as a consolidation of the properties of Milliken Pipe Line Company, Chanute Refining Company, and Cudahy Refining Company. By the end of that year the system consisted of 487 miles of line, mostly in Oklahoma. In 1920, the name was changed to Sinclair Pipe Line Company and had grown to 2600 miles of line. By the time the name was changed to Stanolind Pipe Line Company the system had grown to 6900 miles of line. Since then it has been extended to the 11,450 miles mentioned above.

It is well known that pipe lines are an essential part of the petroleum industry. They are also an important factor in the national transportation picture. Pipe lines transport 12 per cent of the nation's freight and 72 per cent of its crude oil. Service Pipe Line Company has been one of the leaders in the oil industry's postwar movement to improve facilities. Its own particular contribution has been a modernization program, completed a year ago, that virtually doubled its capacity. Now it brings its progressive program to another peak with the completion of this magnificent office building.—F.H.L.

ALCO DIESEL ENGINES pump a mighty river of oil



over 6 million barrels per day . . .

That's the tremendous volume of oil and oil products moved through pipe lines by Alco Diesels—and the record of this engine speaks for itself. More Alco engines have been purchased in the last ten years for oil pumping station service in the U. S. and Canada than any other make.

Reasons for this popularity are easy to find—

Alco pipe line engines are operating up to 98% of elapsed hours per year—*proving dependability.*

Savings up to ⅓ on the cost of principal auxiliary equipment have been made as a result of Alco Diesel's medium speed design.

Maintenance expense has been held to a minimum because standardized design permits interchangeability of practically all wearing parts.

Other features such as compactness, dual fuel operation and a wide speed range make the Alco Diesel engine a "natural" for pipe line pumping installations. For complete details check now with American Locomotive Co., 30 Church St., New York 7, N. Y. or the nearest Alco Sales Office at Beaumont, Chicago, Cleveland, Houston, Kansas City, San Francisco, Schenectady, St. Louis.

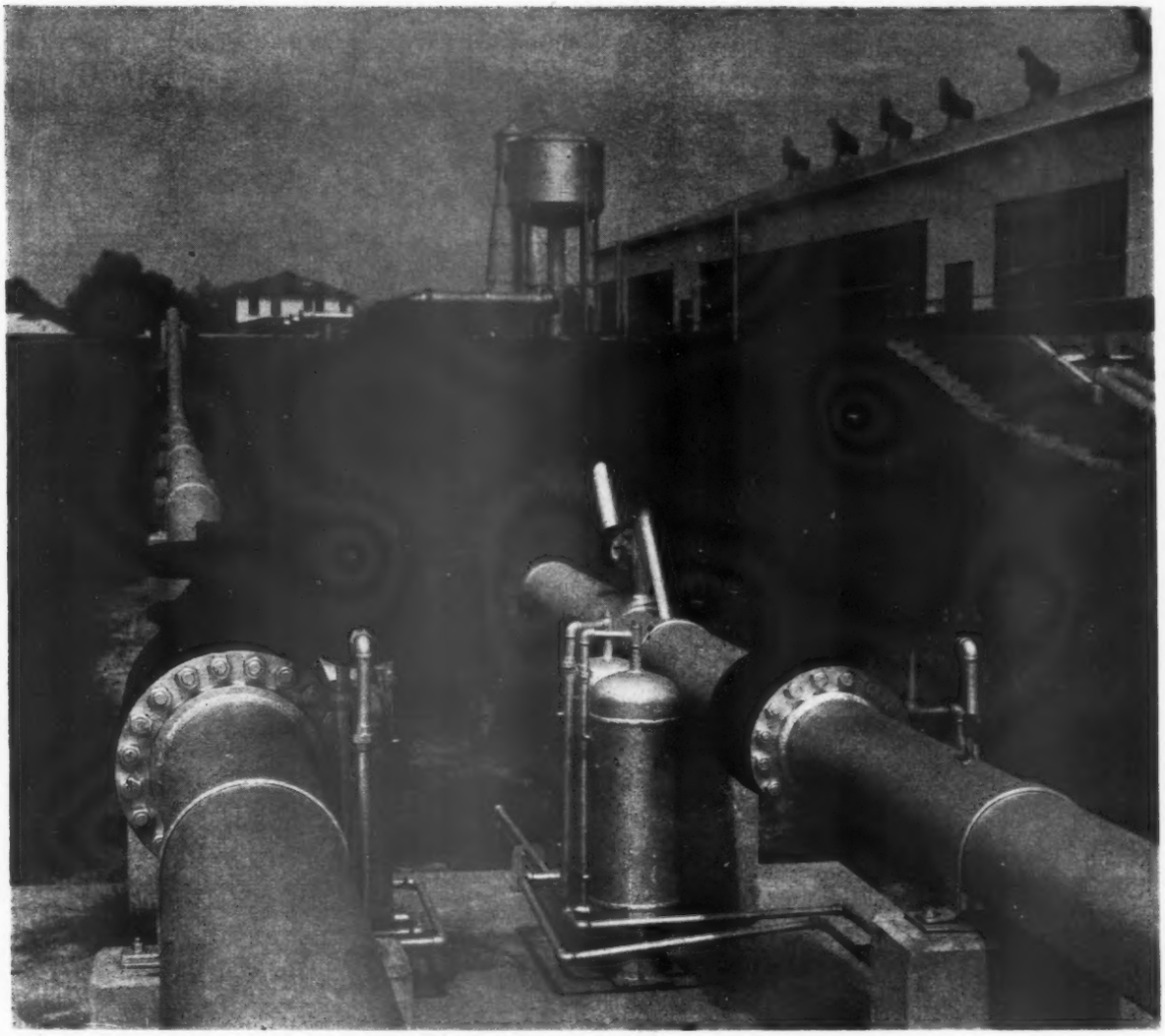
Speed vs. Wear

Remember, since piston speed and journal travel per minute are both almost the same in medium speed and slow speed engines, wear is equivalent as well. Not only do you get unequalled dependability with Alco Diesels—you get long wear and low maintenance costs, no matter how difficult the service conditions.

ALCO DIESELS

THE MARK OF MODERN ENGINEERING

AMERICAN LOCOMOTIVE COMPANY



Remotely controlled head valves at Latex compressor station are closed automatically in event of a blow-out.

Blowout Safety Device

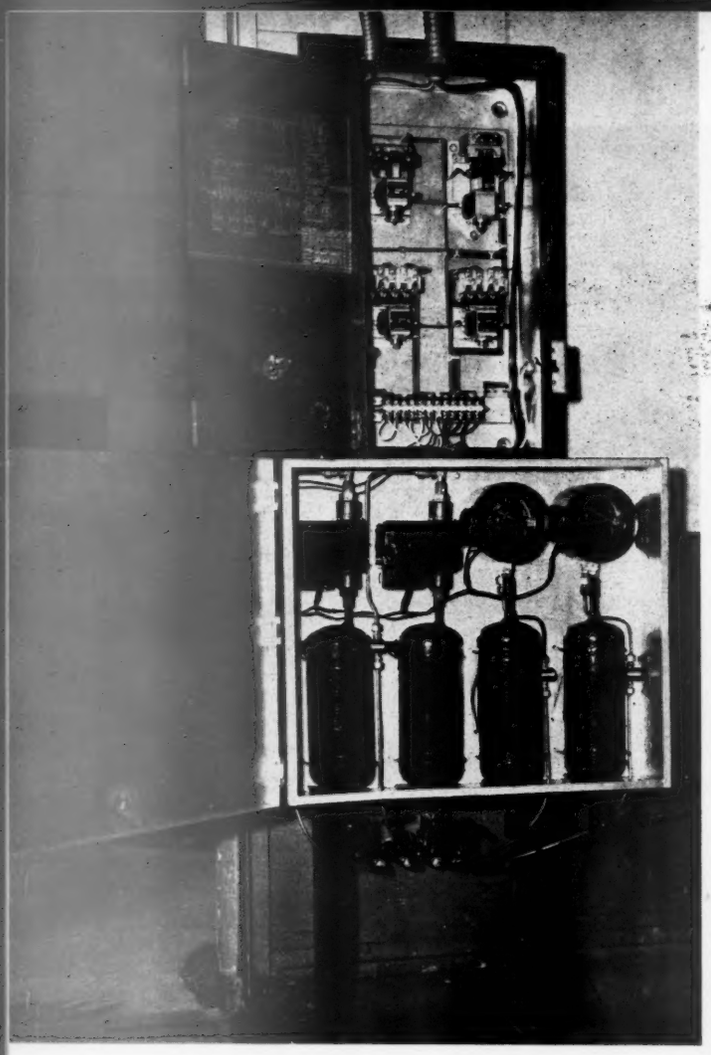
Automatic shut-down controls for compressor stations devised by personnel of United Gas Pipe Line Company.

FRANK H. LOVE*

A BLOWOUT at a gas compressor station can be a disastrous thing. Usually it results in a fire that leaves in its wake untold material loss, but more important, it also may leave in its wake maimed or dead human beings. This could result from an operator being trapped in the affected area and unable to escape, or it could be due to delay occasioned by his effort to shut the plant down before leaving his post. The operating company, without exception, prefers that a workman leave the area of danger as soon after a blowout as possible regardless of what may happen to the plant, but there is no definite assurance that he will do so. Blowouts are few, but they are an ever-present danger, and many and various methods have been devised for coping with the emergency when it occurs. The ideal situation is for a station to shut down automatically in such an event, leaving the operators on duty with no thought other than their own safety. This is exactly what happens at United Gas Pipe Line Company compressor stations where a blowout safety device, developed by company personnel, has been installed. H. W. Egger, general superintendent, and R. C. Henderson, assistant general superintendent, together with cooper-

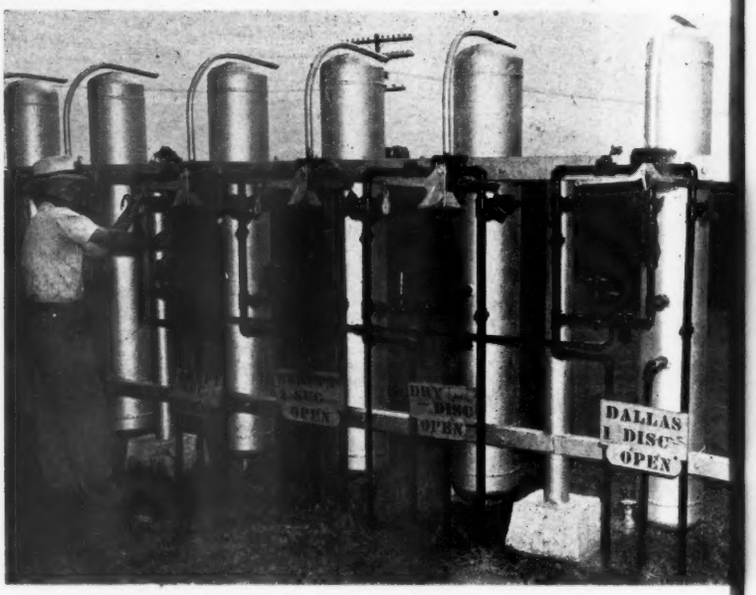
* Editor, Oil and Gas Pipelining.

EXCLUSIVE



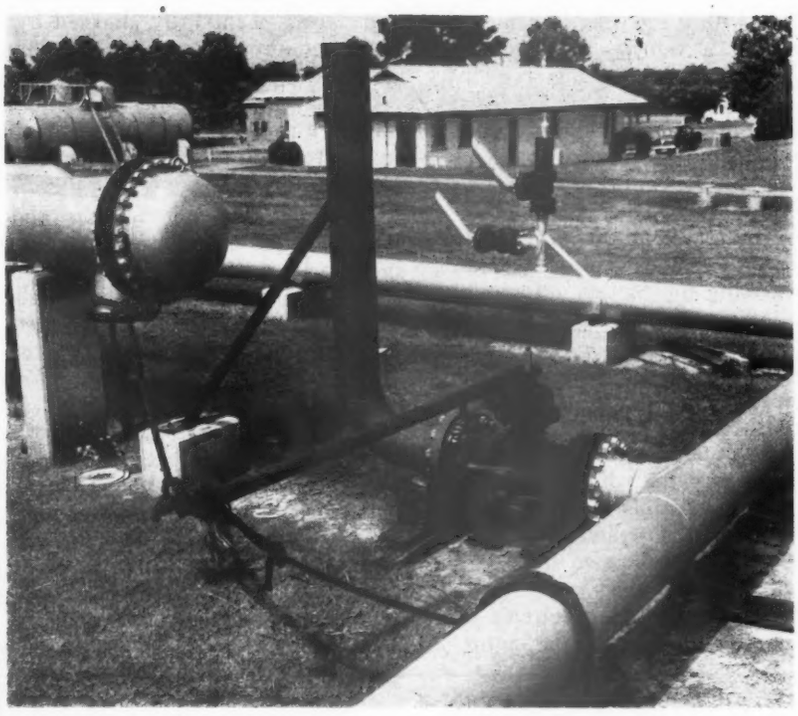
Upper portion of the picture shows the relay panel in use at the Latex station where battery ignition requires fewer relays than would be necessary in a station using magneto ignition engines. The open cabinet in the lower portion of the picture holds the dead end volume chambers, Mercoid differential control switches and other equipment more clearly shown.

Air storage tanks required at the Latex station to close the head valves, an automatic operation when a blowout occurs. W. A. Tabb shows how air can be applied manually when necessary.



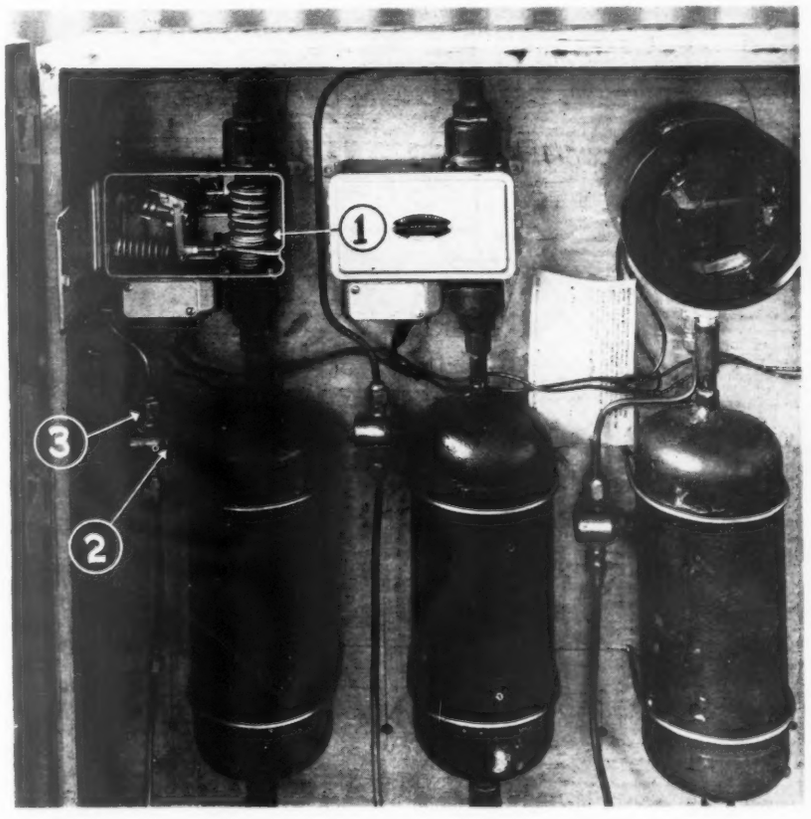
Sterlington compressor station Chief Engineer V. W. Bachus resetting the solenoid valve on the compressed air line.

W. A. Tabb, chief engineer at Latex, points out the manual push button by which the shut-down controls may be operated. Note safety guard.



The close-up picture here shows in detail the Mercoid differential control, which is the heart of the Blowout Safety Device. A sudden drop in pressure on the line protected causes a differential across orifice choke (2). This differential (15 psi or greater) actuates Mercoid differential switch (1), closing electrical circuit to magneto grounding relays or circuit breaker. Current is also applied to a circuit breaker, which closes and energizes motor valves. These valves open and admit air presssure to closing line on remote control head gates. Thus engines are shut down and head gates are closed simultaneously. Check valve (3) prevents sudden pressure being applied to upper bellows of differential switch, which might cause damage. The scored seat in this check valve allows pressure to build up slowly on upper bellows and also acts as a choke to reduce pulsations from line on bellows.

The testing set-up used at Latex to simulate a blowout. A 6-in. orifice in the 8-in. valve was found to be necessary to actuate the automatic shut-down controls, after earlier tests had been made using a 4-in. orifice.



ating employees of United's compressor station department, are responsible for the conception and development of the equipment. Installations have been made at Latex, Sterlington, and Mineola compressor stations.

The equipment consists of several electrical circuits and utilizes both gas and air pressure lines arranged to shut down automatically any number of magneto or battery ignition gas compressor engines, and to close the suction and discharge head gates in event of a break in the high pressure piping within or adjacent to the station.

The suction and discharge headers are piped to two or more small dead end volume chambers, which may be 4 in. by 12 in. or larger. Pipe of 1 in. or 2 in. diam, even larger, may be used up to a point near the volume chamber, where it should be swedged down to ¼ in., the larger lead lines having the greater sensitivity.

Mercoid differential control switches are connected across small chokes placed close to each volume chamber (⅛ in. choke for a 4-in. by 12-in. chamber). These controls are set by the manufacturer to have the greatest sensitivity at the average pressure prevailing in the lines under control but will function satisfactorily over a wide range. When the differential pressure across the chokes increases to 15 psi, the switches close electrical circuits. When the differential pressure decreases to zero, they open the circuits.

A relay and timer is connected to the differential controls. Current for operating the relays is supplied by a 12-volt battery, which is kept fully charged by a trickle charger, to make the device independent of the usual power sources. The timer may be set to open the relay circuit after an interval up to 3 min, during which time all controls will have completed their cycle.

The relay panel incorporates a manual push button for the purpose of testing operation of the relays at intervals. The push button also may be used to operate the shut down controls, which is desirable in event a

gasket should blow out, or a small leak develop that would not release sufficient pressure to actuate the automatic controls.

In addition to the relays that control engine ignition, a single relay is provided to close a circuit connected to electrically operated valves, which open automatically and admit air pressure to close pneumatic remote control suction and discharge head valves. This circuit may also be tied directly to motor-operated head valves.

The differential control is the heart of the blowout safety device. The normal variations in line pressure change the pressures in the dead end volume chamber, but the movement of gas through the choke is not of sufficient velocity to create a differential pressure large enough to close the Mercoid switch. An abrupt lowering of the pressure, which occurs when there is a blowout within the area under control, creates a velocity through the choke by the backflow. This velocity is sufficient to produce the required differential pressure across the orifice, instantly closing the electrical circuit that energizes the shut-down relays.

One or more relays render the engine ignition system inoperative by shorting out magneto ignition engines, or by opening the battery circuit on battery ignition engines. Another relay closes the circuit to the electrically operated valves that open automatically, admitting air from air storage tanks to the line cylinders. The cylinders are situated at the suction and discharge head gates, which are closed in a matter of seconds when air pressure is applied to their hydraulic chambers. The circuit also may control motor-operated head valves.

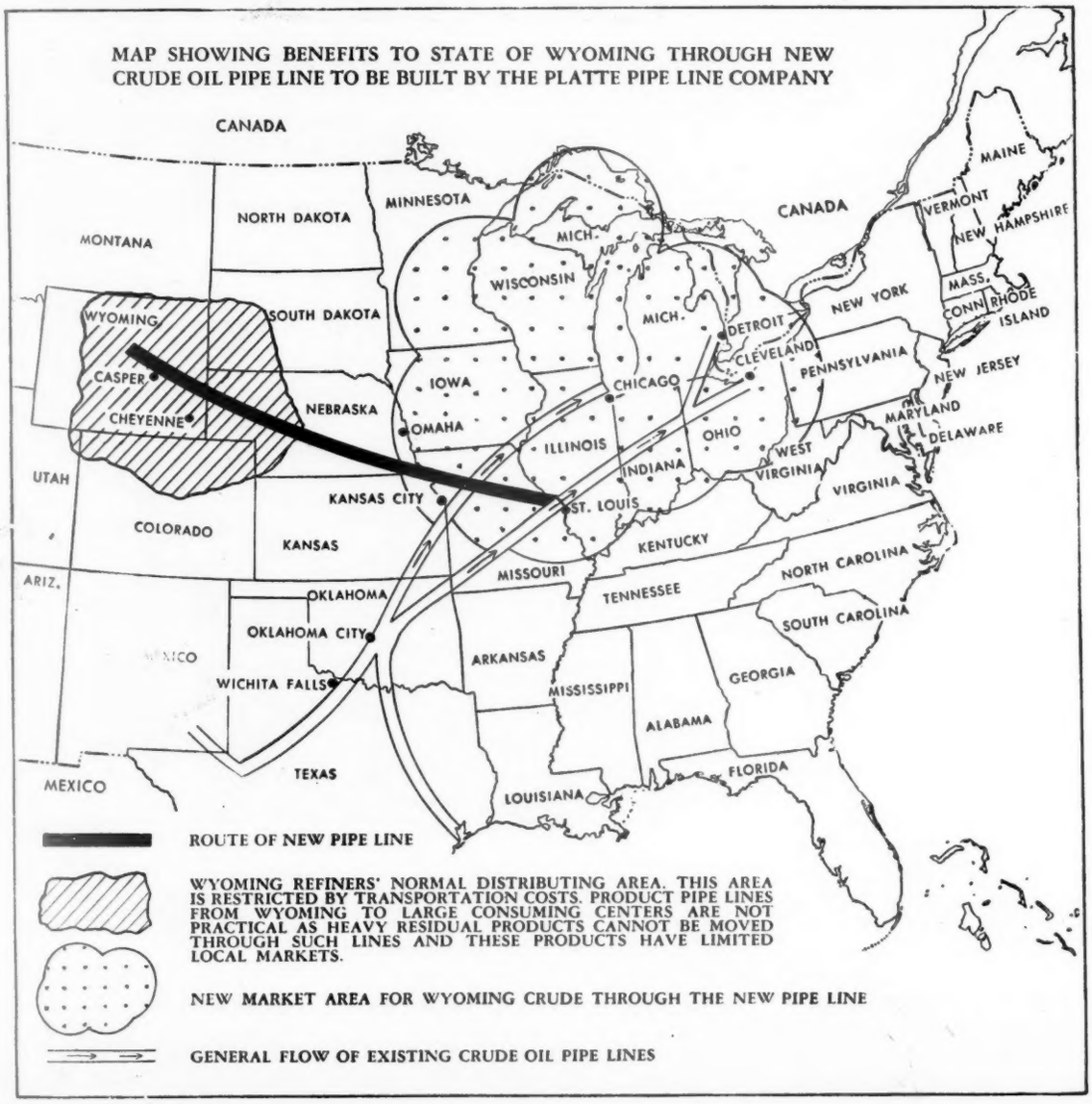
An independent battery circuit of suitable voltage to operate the motor-ized valves—kept fully charged by a trickle charger—completes the automatic shutdown set-up and insures its dependability in any emergency involving a rupture in the pressure lines anywhere within the area between the suction and discharge head valves.

Accompanying photographs show details of the installations at Latex and Sterlington compressor stations. A number of United's stations other than Latex, Sterlington, and Mineola are equipped with automatic shutdowns for engines, although automatic controls are yet to be installed for head valves. Future plans provide for these, as well as for the added safety and efficiency afforded by the blowout safety device, at all compressor plants on the system.

Acknowledgment is made to *United Gas Log* as the source of pictures and descriptive material in this article.

* * *

Platte Pipe Line Will Open New Market Area for Wyoming Crude



Crude Oil and Refined Products Pipe Line Mileage in the United States January 1, 1950

A. T. Coumbe† and I. F. Avery†

THE U. S. Bureau of Mines has completed a survey of petroleum pipe lines by direct correspondence with the oil companies and the use of the records of the Interstate Commerce Commission in order to cover both interstate and intrastate systems. The review shows that crude petroleum and product pipe lines in the United States had a total length of 152,814 miles on January 1, 1950, an increase of 25,463 miles since May 1, 1941, the time of the last previous survey. The expansion in pipe line systems was due largely to new trunk line construction, as the mileage built to carry refined products increased by 11,880 miles, and those intended for crude oil transportation gained 6193 miles. Trunk lines represented 60 per cent of all pipe line mileage on January 1, 1950, compared with 58 per cent in 1941.

The average diameter of trunk lines for crude oil, as calculated on the various sizes and weighted according to their respective lengths, increased to 9.8 in. on January 1, 1950, compared with 8.4 in. on May 1, 1941. The mileage for lines up to 8 in. used in crude trunk lines has decreased since the 1941 survey, whereas those of larger sizes have increased.

The extensive use of large-diameter oil pipe lines has developed since the construction of two major lines from Texas to the East Coast at government expense as a World War II emergency measure. The successful operation of these lines proved their economic advantages over smaller-diameter lines as well as their effectiveness in moving unprecedented volumes of oil during the period when tanker movements were restricted by submarine action in the Atlantic Ocean. The 24-in. diam "Big Inch" line carried more than 300,000 bbl daily of crude oil, and the 20-in. "Little Big Inch" carried more than 230,000 bbl daily of gasoline and light fuel oils to destinations where they were urgently needed.

Although these lines were sold and converted to natural gas service in December 1946, after fulfilling their wartime mission, their record proved

*Reprinted from Bureau of Mines Information Circular 7585 entitled "Crude Oil and Refined Products Pipe Line Mileage in the United States January 1, 1950."

†Commodity specialist, Petroleum and Natural Gas Branch, Fuels and Explosives Division, U. S. Bureau of Mines.

TABLE 1. Salient statistics of pipe line mileage in the United States.

State	Trunk lines (including product lines)					Gathering lines					Total miles				
	1926	1931	1936	1941	1949	1926	1931	1936	1941	1949	1926	1931	1936	1941	1949
Alabama	....	....	....	....	284	....	....	....	....	....	....	....	....	....	284
Arkansas	830	820	650	580	1,063	940	840	650	600	718	1,770	1,660	1,300	1,180	1,781
California	3,210	3,780	2,680	3,590	4,272	1,800	1,820	1,770	2,220	1,976	5,010	5,600	4,450	5,810	6,248
Colorado	8	20	20	115	548	60	90	100	90	133	68	110	120	205	717
Connecticut	....	....	....	22	22	....	....	....	....	....	....	....	....	22	22
Florida	....	....	....	78	78	....	....	....	....	....	....	....	....	78	78
Georgia	....	....	....	380	815	....	....	....	....	....	....	....	....	380	815
Illinois	1,800	3,020	3,110	5,087	6,248	1,170	1,140	940	1,850	3,201	2,970	4,160	4,050	6,937	9,449
Indiana	1,540	1,980	1,980	2,712	3,268	450	410	280	280	389	1,990	2,260	2,260	2,992	3,657
Iowa	77	98	100	1,014	1,327	....	....	....	....	....	77	98	100	1,014	1,327
Kansas	2,430	3,440	3,770	6,085	6,110	3,220	3,500	3,910	4,040	6,265	5,650	6,940	7,680	10,125	12,375
Kentucky	570	540	430	500	217	1,660	1,700	1,340	1,310	786	2,230	2,240	1,770	1,810	1,003
Louisiana	1,890	1,890	2,200	2,015	3,003	720	900	1,100	1,320	1,627	2,610	2,790	3,300	3,335	4,630
Maine	....	....	....	....	200	....	....	....	....	....	....	....	....	....	200
Maryland and D. C.	33	33	....	....	77	....	....	....	....	....	33	33	....	....	77
Massachusetts	....	....	....	153	177	....	....	....	....	....	....	....	....	153	177
Michigan	138	325	490	940	1,057	....	160	250	430	715	138	485	740	1,370	1,772
Minnesota	....	....	....	248	974	....	....	....	....	....	....	....	....	248	974
Mississippi	....	....	....	....	438	....	....	....	20	393	....	....	....	20	831
Missouri	2,490	4,170	4,180	5,183	6,063	....	....	....	....	....	2,490	4,170	4,180	5,183	6,063
Montana	130	60	100	140	319	20	215	350	350	523	150	275	450	490	842
Nebraska	404	404	390	583	1,050	....	....	....	10	24	404	404	390	593	1,074
New Hampshire	....	....	....	....	38	....	....	....	....	....	....	....	....	....	38
New Jersey	480	190	180	259	328	....	....	....	....	....	480	190	180	259	328
New Mexico	70	150	300	450	594	20	350	450	900	1,618	90	500	750	1,350	2,212
New York	1,200	210	200	817	766	710	610	550	600	480	1,910	820	750	1,417	1,246
North Carolina	....	....	....	....	111	....	....	....	....	....	....	....	....	....	111
North Dakota	....	....	....	....	81	....	....	....	....	....	....	....	....	....	81
Ohio	2,690	2,580	2,360	3,109	4,307	6,320	5,780	5,620	4,940	3,299	9,010	8,360	7,980	8,049	7,606
Oklahoma	8,220	10,990	10,170	9,646	9,584	10,960	13,510	11,510	10,280	9,245	19,180	24,500	21,680	19,926	18,829
Pennsylvania	5,260	3,510	3,470	5,119	6,082	6,340	6,540	5,810	5,690	4,796	11,600	10,050	9,280	10,809	10,878
Rhode Island	....	....	....	17	13	....	....	....	....	....	....	....	....	17	13
South Carolina	....	....	....	....	102	....	....	....	....	....	....	....	....	....	102
South Dakota	....	....	....	24	182	....	....	....	....	....	....	....	....	24	182
Tennessee	....	....	....	....	109	30	15	10	....	....	30	15	10	....	109
Texas	9,470	18,880	20,290	23,465	29,034	6,060	10,460	12,600	13,420	20,149	15,530	29,340	32,890	36,885	49,183
Utah	....	....	....	80	287	....	....	....	....	....	....	....	....	80	287
Vermont	....	....	....	....	59	....	....	....	....	....	....	....	....	....	59
West Virginia	400	320	260	330	587	5,000	4,910	4,820	4,480	3,660	5,400	5,230	5,080	4,810	4,247
Wyoming	1,130	610	490	1,440	2,344	220	690	700	340	563	1,350	1,300	1,190	1,780	2,907
Total	44,470	58,020*	57,820†	74,181	92,254	45,700	53,640	52,760	53,170	60,560	90,170	111,660*	110,580†	127,351	152,814

* Excludes 1400 miles of gasoline pipeline, breakdown by states not available.
† Excludes 4600 miles of gasoline pipeline, breakdown by states not available.

to the industry that significantly lower operating and investment costs per barrel-mile of oil moved could be achieved than were possible with the comparatively small lines in general use up to that time. Hence, the several major oil pipe line projects that have been constructed since the late war are of large diameter pipe. To assure supplies and market outlets of sufficient magnitude to support such lines and provide adequate flexibility, ownership is often shared by several large companies whose transport needs are served in common. The principal recent expansion in facilities has been from supply points in Southwestern states toward markets in the North and East and to Gulf tidewater.

Gathering lines in the last 9 years have increased by 14 per cent, or from 53,170 miles reported in 1941 to 60,560 miles as of January 1, 1950. (See Table 2.) The greatest gain is reported for Texas, where the mileage of gathering lines increased by 6729 miles, whereas changes in other states have been relatively unimportant. Gathering lines were not reported by sizes in the 1941 survey; however, the trend towards greater use of 4 and 6-in. sizes in gathering lines was evident even before 1936, according to earlier surveys. In 1936, gathering lines 4 in. and larger made up 45 per cent of the total, compared with 56 per cent on January 1, 1950.

Crude oil trunk lines increased by 6193 miles in the 1941-1949 period. (See Table 3.) Pipe lines 10 in. and over were greater by 8748 miles, whereas the smaller sizes decreased by 2555 miles in this interval. The larger trunk lines of 12 in. and over gained 6958 miles, showing the greatest expansion for sizes over 12 in., which gained 4641 miles. These larger pipe sizes averaged about 20 in. in diameter.

Crude oil trunk lines increased in most states. Texas, with 3539 miles of new lines since 1941, continues to lead other states by a substantial margin. Important expansion also took place in Illinois, Louisiana, Missouri, Ohio, and Wyoming. Reductions in crude trunk line mileage were reported for California, Kansas, Kentucky, New York, Oklahoma, and Pennsylvania. Kansas showed the greatest loss in mileage—918 miles.

The mileage of refined products trunk lines increased by 11,880 miles. (See Table 5.) They have more than doubled since 1941, as the oil companies have come to recognize the efficiency and lower comparative cost of this method of distribution. Product lines are operated in 35 states and the District of Columbia at the present

TABLE 2. Mileage of crude oil and natural gasoline gathering lines, by size of pipe, as of January 1, 1950. (Odd sizes are included in next smaller size.)

State	Inches							
	2	3	4	6*	8†	10	over 10	Total
Arkansas	159	50	355	111	41	2	....	718
California	29	158	511	878	337	56	7	1,976
Colorado	2	....	63	50	8	2	8	123
Illinois	545	805	1,426	255	125	43	2	3,201
Indiana	110	191	69	17	1	1	....	389
Kansas	945	1,409	2,510	721	571	92	17	6,265
Kentucky	550	170	26	39	1	....	....	786
Louisiana	262	88	695	394	181	2	5	1,627
Michigan	38	232	289	141	15	....	....	715
Mississippi	67	23	210	52	24	3	14	393
Montana	116	227	126	40	12	1	1	523
Nebraska	....	3	21	....	....	....	....	24
New Mexico	104	135	1,056	246	64	13	....	1,618
New York	338	112	26	4	....	....	....	480
Ohio	1,821	735	554	188	1	....	....	3,299
Oklahoma	2,447	1,574	2,863	1,802	523	32	4	9,245
Pennsylvania	3,489	935	283	88	1	....	....	4,796
Texas	3,912	2,097	9,327	3,650	1,017	120	26	20,149
West Virginia	2,309	629	347	364	10	1	....	3,660
Wyoming	6	82	183	184	98	8	2	563
Total January 1, 1950	17,249	9,655	20,940	9,224	3,030	376	86	60,560
Total May 1941‡								53,170

* Includes a small mileage of 5-in. pipeline.
† Includes a small mileage of 7-in. pipeline.

TABLE 3. Mileage of crude oil trunk lines, by size of pipe, as of January 1, 1950. (Odd sizes are included in next smaller size.)

State	Inches							
	Under 4	4	6*	8†	10	12	Over 12	Total
Arkansas	32	78	201	194	8	....	296	809
California	4	62	449	1,742	573	244	185	3,259
Colorado	14	1	56	7	338	1	....	417
Illinois	15	195	328	1,664	1,054	1,047	581	4,884
Indiana	10	33	343	1,139	686	322	24	2,557
Iowa	....	....	....	20	2	65	17	104
Kansas	125	206	786	1,365	612	681	243	4,018
Kentucky	80	97	34	....	....	....	....	211
Louisiana	13	196	561	986	226	461	16	2,459
Maine	....	....	....	....	....	73	3	76
Michigan	5	126	395	400	1	1	....	928
Mississippi	3	22	36	96	102	13	....	272
Missouri	3	2	12	1,399	1,714	1,343	691	5,164
Montana	43	42	152	16	....	66	....	319
Nebraska	1	4	1	1	51	248	137	443
New Hampshire	....	....	....	....	....	38	....	38
New Jersey	....	....	126	50	....	1	....	177
New Mexico	....	93	73	260	51	10	107	594
New York	27	40	81	81	1	....	....	230
Ohio	23	21	678	1,836	256	280	83	3,177
Oklahoma	207	536	1,401	3,448	1,187	694	974	8,447
Pennsylvania	440	207	2,072	569	5	4	....	3,297
Texas	117	659	3,601	11,345	6,320	2,968	1,399	26,409
Utah	....	....	26	79	182	....	....	287
Vermont	....	....	....	....	....	59	....	59
West Virginia	70	....	481	25	3	1	....	580
Wyoming	1	148	361	1,058	128	407	55	2,158
Total January 1, 1950	1,233	2,768	12,254	27,780	13,500	9,027	4,811	71,373
Total May 1941	1,050	3,590	12,570	29,380	11,710	6,710	170	65,180

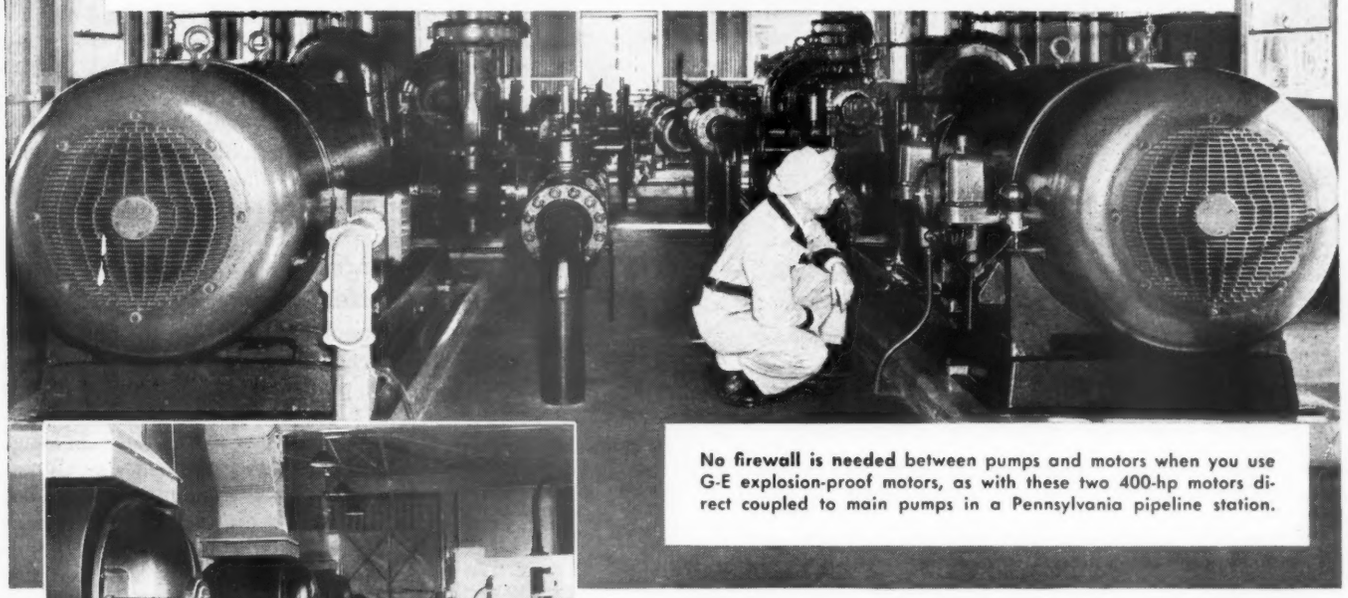
* Includes a small mileage of 5-in. pipeline.
† Includes a small mileage of 7-in. pipeline.

TABLE 4. Mileage of crude oil and refined products pipe lines in the United States, by sizes, June 30, 1936, May 1, 1941, and January 1, 1950.

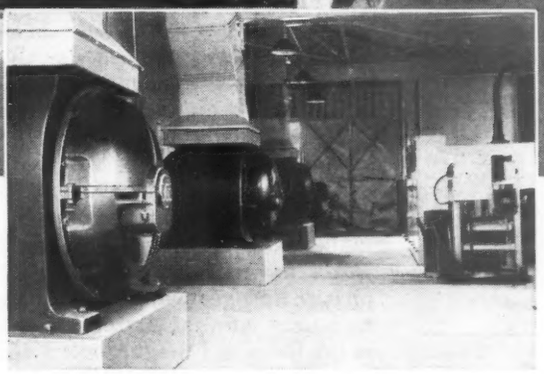
Size (I.D.)*	Trunk lines					Gathering lines		
	Crude oil			Products				
	1936	1941	1949	1941	1949	1936	1941	1949
2-in	.....	.....	.....	.....	.....	19,620		17,249
3-in	.....	.....	.....	.....	.....	9,220		9,655
Below 4-in	1,270	1,050	1,233	162	391	.....		.....
4-in	3,990	3,590	2,768	692	1,366	13,550		20,940
6-in	10,460	12,570	12,254†	3,781	6,696	7,680	Not	9,224
Above 6-in	.....	.....	.....	.....	.....	2,690	available	3,492
8-in	27,060	29,380	27,780	4,230	9,979	.....		.....
10-in	9,450	11,710	13,500	68	1,628	.....		.....
12-in	5,510	6,710	9,027	68	817	.....		.....
Above 12-in	80	170	4,811	.....	4	.....		.....
Total U. S.	57,820	65,180	71,373	9,001	20,881	52,760	53,170	60,560

* Data for odd sizes are included in next smaller size listed.
† Includes a small mileage of 5-in. pipe.

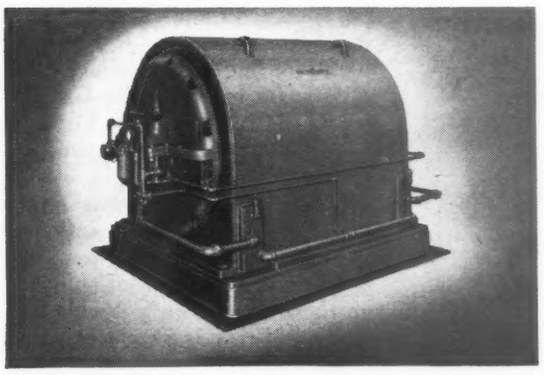
MOTORS TO MATCH YOUR PIPELINE NEEDS



No firewall is needed between pumps and motors when you use G-E explosion-proof motors, as with these two 400-hp motors direct coupled to main pumps in a Pennsylvania pipeline station.



Where a firewall is called for by station design, choose G-E squirrel-cage open induction motors for low-cost reliability. Here, three 1500-hp motors of this type, with top air-discharge enclosures, drive the pumps through a firewall in a Southern pipeline station.



No firewall is used with this 1500 hp G-E externally forced base-ventilated motor, one of several now being installed in a large Southwestern crude line. A separate motor-driven blower purges the motor and duct system of hazardous gases. Air ducts are located below the floor level.

Broad range of G-E motors makes correct selection easier

When you make General Electric your single supply source for all your electrified pipeline needs, you're sure of the widest variety of motor types and sizes to choose from:

Motors that meet any area condition—low-cost open motors to operate behind a firewall, or enclosed motors designed for use in hazardous areas which require no firewall.

Motors for centrifugal or reciprocating pumps—squirrel-cage induction motors of relative simplicity and low cost for centrifugal pumps, or synchronous motors with high operating efficiency and ability to improve load power factor for reciprocating pumps.

Motors for constant or adjustable speed—constant-speed motors direct-coupled to centrifugal pumps for lowest installed cost, or wound-rotor induction motors to supply adjustable speed for more efficient operation at reduced flow.

All these G-E motors offer the advantages of fast and easy installation, minimum maintenance, and long-lasting dependability. Selected with the aid of G-E application engineers who know pipeline industry needs, they're a good bet to help cut your pumping costs. For the full story, call your nearest G-E office. *Apparatus Dept., General Electric, Schenectady 5, N. Y.*

Worth seeing! It's "Lease on the Future", G-E's More Power to America movie on oil field electrification. Ask your G-E representative to arrange a showing.

Everything you need
o cut oil pipeline costs
—ELECTRICALLY!

GENERAL ELECTRIC

TABLE 5. Mileage of refined products trunk lines, by size of pipe, as of January 1, 1950.
(Odd sizes are included in next smaller size.)

State	Inches							
	Under 4	4	6*	8	10	12	Over 12	Total
Alabama	...	72	....	12	....	200	..	284
Arkansas	12	37	....	55	150	...	..	254
California	150	229	384	206	23	21	..	1,013
Colorado	...	....	84	83	....	...	..	167
Connecticut	...	....	22	....	....	...	..	22
Florida	...	....	....	78	....	...	..	78
Georgia	...	167	146	343	147	12	..	815
Illinois	1	1	289	888	173	12	..	1,364
Indiana	1	1	30	665	4	9	1	711
Iowa	6	2	823	271	121	...	..	1,223
Kansas	...	151	675	1,265	....	1	..	2,092
Kentucky	...	....	6	....	....	...	..	6
Louisiana	...	21	81	189	174	79	..	544
Maine	...	....	124	....	....	...	..	124
Maryland (and D. C.)	...	....	77	....	....	...	..	77
Massachusetts	...	....	177	....	....	...	..	177
Michigan	...	....	129	....	....	...	..	129
Minnesota	...	....	443	405	126	...	..	974
Mississippi	...	....	....	....	....	166	..	166
Missouri	...	....	13	886	....	...	..	899
Nebraska	...	....	153	454	....	...	..	607
New Jersey	...	....	....	150	....	1	..	151
New York	1	17	262	256	....	...	..	536
North Carolina	...	....	....	3	108	...	..	111
North Dakota	...	....	81	....	....	...	..	81
Ohio	8	46	749	326	....	1	..	1,130
Oklahoma	...	183	286	667	....	1	..	1,137
Pennsylvania	73	88	1,097	1,347	64	116	..	2,785
Rhode Island	...	....	....	13	....	...	..	13
South Carolina	...	....	....	....	102	...	..	102
South Dakota	...	....	130	52	....	...	..	182
Tennessee	...	....	5	104	....	...	..	109
Texas	139	351	415	1,083	436	198	3	2,625
West Virginia	...	....	7	....	....	...	..	7
Wyoming	...	....	8	178	....	...	..	186
Total January 1, 1950	391	1,366	6,696	9,979	1,628	817	4	20,881
Total May 1941	162	692	3,781	4,230	68	68	..	9,001

* Includes a small mileage of 5-in. pipeline.

TABLE 6. Cubic capacity (pipe line fill) for gathering line and trunk lines, by states, thousands of barrels.

State	Gathering lines			Crude oil trunk lines			Refined products,
	June 30, 1936	May 1, 1941	Jan. 1, 1950	June 30 1936	May 1, 1941	Jan. 1, 1950	Jan. 1, 1950
Alabama	....		....	....	....	....	158
Arkansas	66		70	202	184	720	98
California	311		356	1,018	1,280	1,442	188
Colorado	7	Not	24	3	18	187	43
Connecticut	....	available	....	....	....	....	4
Florida	....		....	....	....	....	26
Georgia	....		....	....	....	....	238
Illinois	58		227	1,353	1,910	3,129	443
Indiana	26		21	738	1,025	1,079	234
Iowa	....		....	55	55	90	303
Kansas	375		671	1,229	1,662	1,931	553
Kentucky	49		29	47	56	18	1
Louisiana	116		203	734	713	933	226
Maine	....		....	....	....	54	23
Maryland	....		....	....	....	....	14
Massachusetts	....		....	....	....	....	33
Michigan	16		66	116	189	216	24
Minnesota	....		....	....	....	....	279
Mississippi	....		49	....	....	102	123
Missouri	....		....	1,948	2,302	4,048	293
Montana	....	Not	36	15	15	88	....
Nebraska	28	available	2	255	253	438	177
New Hampshire	....		....	....	....	28	....
New Jersey	....		....	39	28	40	50
New Mexico	48		168	80	150	318	....
New York	18		15	22	45	44	134
North Carolina	....		....	....	....	....	56
North Dakota	....		....	....	....	....	15
Ohio	266		152	694	870	1,275	250
Oklahoma	1,020		882	2,847	2,804	4,564	291
Pennsylvania	186		154	649	625	612	772
Rhode Island	....		....	....	....	....	4
South Carolina	....		....	....	....	....	52
South Dakota	....		....	....	....	....	41
Tennessee	....		....	....	....	....	35
Texas	1,318		2,031	7,972	8,762	12,773	840
Utah	....		....	....	22	124	....
Vermont	....		....	....	....	44	....
West Virginia	275		176	53	54	103	1
Wyoming	139		91	149	426	905	62
Total	4,332		5,473	20,218	23,448	35,306	6,084

time, and a new one is being extended to the states of the Pacific Northwest. Pennsylvania, with 2785 miles of product lines, continues to lead other states in mileage, however, Texas showed the greatest gain, as more than 2000 miles of new product lines have been put in operation there since 1941.

The calculated volumetric capacity of crude lines in 1936 was 24,540,000 bbl, and this had increased to 40,779,000 bbl by the end of 1949. These theoretical cubic capacities, shown separately by trunk and gathering lines and by states, are included in Table 6. The gathering-line fill is not available in the 1941 survey, as data on line sizes were lacking. * * *

Princeton's Geology Students Study Transco

Faculty members of the department of geology at Princeton University have put Transco, the world's longest gas pipe line, now approaching this town two miles west of the borough line, to a very practical use. Where else could their students obtain a better close-up view of soil profile, many miles in length, in a trench that is closely related to business, current events, and international affairs?

In the department's courses for beginners, emphasis is placed on field work, and trips are scheduled to emphasize how geological science applies to human affairs. Actual weathering in the fields and the formation of soils are observed, and the relationship of conservation programs and mineral resources to engineering and industry is explained.

Thus, a trench such as the one the Transcontinental Gas Pipe Line Corporation is now digging in the vicinity of Princeton, New Jersey, to extend its 30-in. line farther along the 1832-mile route from the Rio Grande Valley to 134th Street, New York City, is for geological teaching purposes a "natural".

While the great pipe line moves toward its ultimate destination it is, therefore, providing a real base of operations for groups of students who go there by bus on a double-barreled mission. This mission, as explained by Professor Edward Sampson, is to study the soil formations uncovered by Transcontinental and to observe at first hand how the work of the geologist relates to business and to our national economy. For, indeed, the piping of natural gas from the Southwest to the Mid-Atlantic seaboard provides an excellent illustration of this relationship.

Eventually, the pipe line will skirt the northern end of Princeton Borough and head off north of Kingston.

Pumps for Army Pipe Lines

Two new units for handling liquid fuel are designed for use over broad range of operational conditions.

Gasoline-engine-driven centrifugal pump having 6-in., 250-psi flanged discharge and suction, with 6-in. adapters for couplings. Capacity is 300 gal per min against a 625-ft head to 1200 gal per min against a 350-ft head, or in parallel, 560 gal per min against a 312-ft head to 2400 gal per min against a 175-ft head, at 2100 rpm.

Two new pumps designed by the Engineer Research and Development Laboratories at Fort Belvoir, Virginia, for liquid fuel handling can be used over such a broad range of operational conditions that they will simplify greatly the military supply and maintenance problems. It is planned that the units, intended primarily for petroleum distribution pipe lines in theatres of operations, will also be used on water supply systems.

The 2-stage and 4-stage centrifugal pumps cover a wide range of capacities and pressures. They may be operated either singly or in series up to three units. The capacity range is from 10 to 2800 gal per min at pressures up to 200 psi. When operated in series, the resultant highest pressure is 600 psi. This range meets all bulk petroleum handling requirements.

The 4-stage unit was designed as an improvement over the World War II "Pup" because of difficulties encountered in field maintenance, the necessity of using a gasoline-cooled gear case, and the need for high-speed operation in order to develop sufficient pressure. Intended for continuous duty on either 4-in. or 6-in. overland Army pipe lines, the pump weighs 3500 lb. Its capacity on the 4-in. line, with 20-mile station spacing over level ground, is approximately 170 gal per min at 500 psi. Its capacity on the 6-in. line, under the same conditions, is 400 gal per min at a pressure of 380 psi.

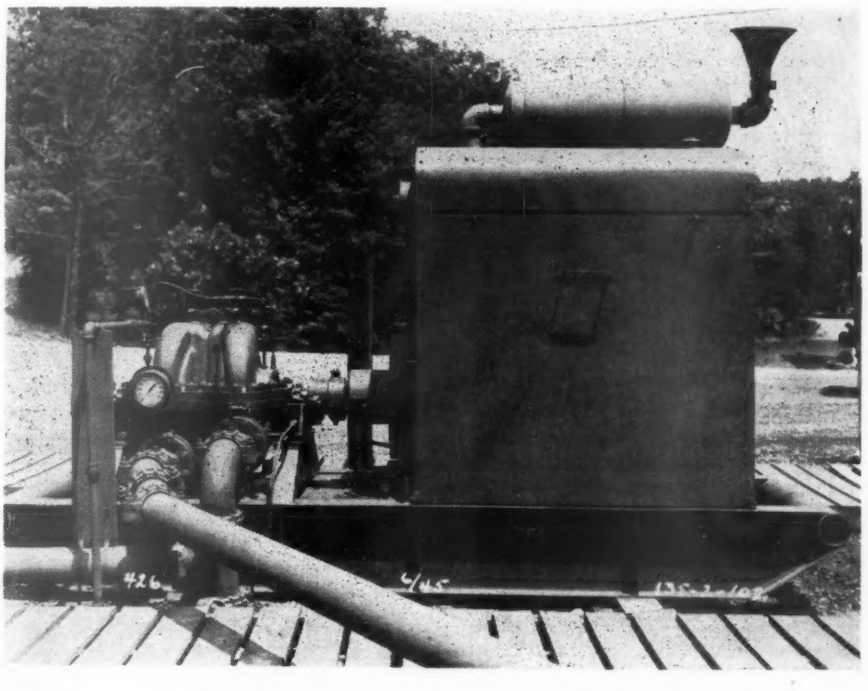
The higher capacity 2-stage pump, designed to be suitable for many Army, Navy, and Air Force uses, weighs 4700 lb. Its double suction and double discharge makes possible the operation of the two impellers either in series or parallel.

Continuous duty on 6 and 8-in. Army pipe lines were the primary prerequisites of the design of this pump. When operated on these overland pipe lines, capacities are 500 and 900 gal per min, respectively, with 20-mile station spacing over level ground. When used as a booster pump to assist tanker unloading pumps the unit operates with impellers in parallel at a capacity of 2800 gal per min.

Increased dependability and simplification of maintenance are effected on both the 2- and 4-stage pumps through use of the threadless shafts and horizontally split casings. Other design advantages are direct connection between pump unit and engine and relatively slow speed operation.

Both pumps are completing operational tests at the Engineer Research and Development Laboratories at this time. * * *

Gasoline-engine-driven centrifugal pump having 3-in., 250-psi flanged discharge and suction, with adapters for 4-in. grooved type pipe. Capacity is 180 gal per min against a 650-ft head to 500 gal per min against a 360-ft head at 2000 rpm, or 150 gal per min against a 550-ft head to 400 gal per min against a 400-ft head at 1850 rpm.



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P 615.512.

CRANKCASE EXPLOSIONS*

Experience with crankcase explosions is discussed, as well as the reasons for them, and suggestions are made on how they might be avoided.

F. V. COOK†

CRANKCASE explosions in engines and other equipment have occurred occasionally since the first machinery was manufactured with enclosed crankcases. They have become more frequent since the crankcases of all engines have been tightly enclosed to accommodate pressure lubrication. The modern trend toward housing all auxiliary drives within the crankcase, close running fits of pistons and journals, higher operating speeds, and the use of extremely thin babbitt bearings has added possibilities of overheated surfaces. The mechanical derangement of these parts provides the heat necessary for both vaporization and ignition of the lubricating oil.

There have been few publicized reports of crankcase explosions and engine operators and builders have been reluctant to discuss them. It is the writer's opinion that if each were completely described in the trade journals and other reports a large amount of valuable information would be obtained. It is proposed in this paper only to start such a discussion by reporting the experiences of the Service Pipe Line Company and our approach to the problem.

All of the literature and discussion on crankcase explosions with which the writer is familiar starts with two assumptions, viz.:

(1) The oil and air mixture in an engine crankcase is normally too rich to burn.

(2) Piston blow-by consists primarily of the products of combustion.

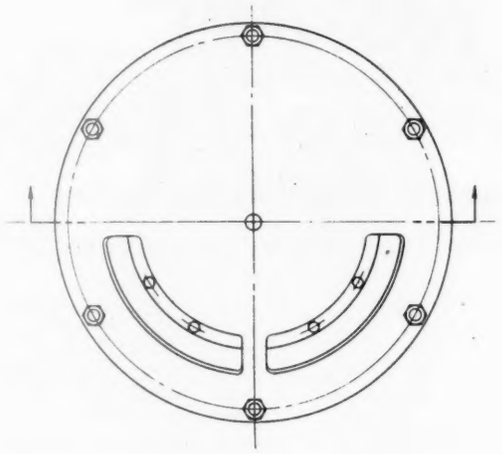
It is maintained that both of these assumptions are fallacious. *Explosions result from ignited mixtures of vapor and air that fill the spaces between the droplets of oily mist in crankcases; piston blow-by is negligible except during the compression stroke.* These are the conclusions resulting from many tests of diesel, gas, and dual fuel engine crankcases that were made by drawing the contents of the crankcase from a shielded area to avoid including drops of lubricating oil. All natural gas engines the crankcases of which were vented only to the atmosphere were found to contain explosive mixtures. Diesel engines contained little or no explosive vapors even when not vented. Unvented dual fuel engines that compress air-gas mixtures show practically no trace of combustible gas in the crankcases when burning liquid fuel. After the gas fuel is admitted the crankcase vapors rapidly increase in gas content to approximately the same mixture that is being burned. By connecting the crankcase to the engine air intake and opening a vent in the opposite end, this gas-air mixture can rapidly be displaced with air. These tests, performed many times, can lead only to the conclusion that there is sufficient blow-by on the compression stroke of every engine to place in the crankcase the same mixture that is being compressed by the piston. No appreciable quantities of carbon monoxide or carbon dioxide have been found in the crankcases of diesel or gas engines, even when the piston rings were in poor condition. In groping for an explanation, the writer remembers slow-speed engines blowing by the rings in which the sound of the leakage practically stopped at the end of the compression stroke. Another possible reason is the distance of the ring belt from the start of combustion. If the engine is burning all of its fuel, the excess air occupies the space adjacent to the rings because it is farthest from the start of combustion. It is hoped these statements will prompt laboratory tests by some of the engine builders that will prove or disprove the suppositions.

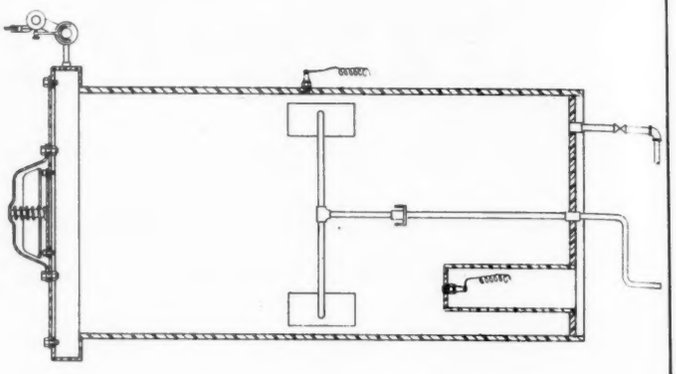
Many of you have heard that the Service Pipe Line Company experienced two serious crankcase explosions on new dual fuel engines soon after they were placed in service during the latter part of 1948. We have experienced another, on an older engine, since the first of this year. The first and second explosions resulted from hot auxiliary drive bearings in the front end of new 7-cylinder, 1600-hp engines. The first explosion, occurring while the engine was operating on liquid fuel, blew off two thin sheet steel doors and set the engine crankcase afire. Damage to the building was slight. The second explosion occurred while operating on both liquid and gas fuel, and blasted all but one door from the engine crankcase and also set the crankcase afire. Damage to the building was extensive. Many windows were broken and the transite roof was so badly damaged that replacement was necessary. A wooden partition, placed in the end of the building in preparation for removing the end wall, was blown out. The most recent explosion resulted from hot main and crank bearings in a 6-cylinder, 500-hp engine that had been converted to dual fuel. This explosion caused slight damage to the building and no damage to the engine except breakage of one of the cast-iron crankcase doors. It was not followed by fire. We were extremely fortunate that no one was injured because any of these explosions could have been fatal had an employee been in the path of the doors that were blown from the engines. Serious burns could have resulted from being close to the engines at the time of the explosions. Secondary, more violent, crankcase explosions are usually reported in papers on this subject. All explosions described here were witnessed by operating personnel but there was no evidence of secondary explosions in these instances.

Both 1600-hp engines were vented at the front end through a 2-in. line and an Air-Maze separator to the engine air intake, but the crankcase was not open for air inlet except for leakage and via the front end lubricating

*Presented before the Petroleum Mechanical Engineering Conference of The American Society of Mechanical Engineers, New Orleans, Louisiana, September 25-29, 1950.

†Master Mechanic, Service Pipe Line Company (formerly Stanolind Pipe Line Company).

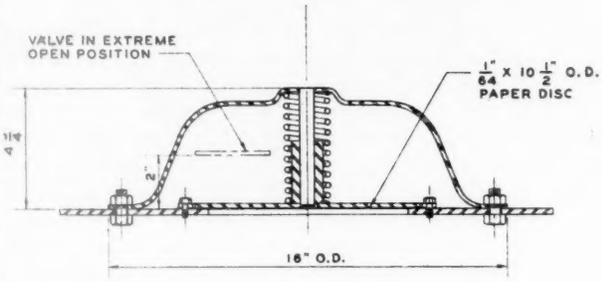




TEST TANK WITH RELIEF DOOR

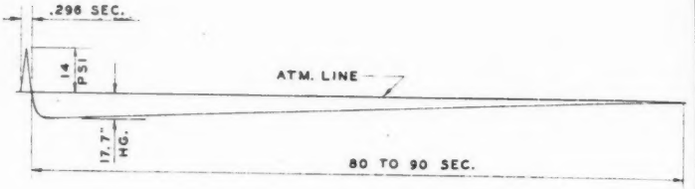
VOL. = 25 CU. FT.

FIG. 2



CRANKCASE EXPLOSION RELIEF VALVE

FIG. 1



TEST TANK PRESSURES

NATURAL GAS CHARGE 1.5 CU. FT.

FIG. 3

oil return line to the open lubricating oil sump tank. Thus, practically all air passing through the crankcases was passing the bearings that caused the explosions. Subsequent tests, under identical operating conditions, proved that the crankcases were practically free of combustible vapors in the front end before the bearings heated and vaporized lubricating oil, but contained increasing amounts of combustible vapor toward the flywheel end, farthest from the vent until the mixture stabilized at approximately the same ratio that was being compressed by the pistons.

The 500-hp engine was fitted with a similar separator and a ¾-in. vent line. The separator was stopped up and there was no opening in the crankcase to admit air, so for all practical purposes the engine had no vent, although the separator would not hold measureable pressure in the crankcase. All these engines have been provided with forced ventilation by connecting the crankcase to the air intake and opening the opposite end of the crankcase to admit air. We are not certain that this is the proper procedure because explosions are more frequent in diesel than in spark-ignited gas engines, and most of the latter carry explosive mixtures in the crankcase. This may possibly be explained by assuming that the mixture becomes too rich to detonate soon after mechanical derangements start adding lubricating oil vapors to the gas-oil mixture. The higher temperature required to ignite methane mixtures may also be a partial explanation (petroleum vapors, approximately 1000 F; methane vapors, about 1500 F).

A study of preventive measures suggests the following:

(1) Maintain a non-explosive mixture in the crankcase. One method of doing this would be to pass natural gas through the crankcase to the engine intake. (This has not been seriously considered because of the hazard of explosive mixtures each time the crankcase was opened.)

(2) Provide means of drenching the crankcase with carbon dioxide when trouble occurs. (This idea was abandoned because of the high cost and the fact that it would seldom be used when needed. Vapor detector equipment is high priced, also, and not reliable for continuous use in such a large area.)

(3) Strengthen the crankcase to withstand an explosion. (This could not be seriously considered on our engines, many of which are 30 years old. It should be considered for new engines, especially in smaller sizes.)

(4) Remove from the crankcase, insofar as possible, all sources of hot surfaces. (This, again, would not be practicable in old engines but should be considered in the purchase of new engines. Tin-plated pistons, as an example, go far to remove a source of hot surfaces.)

(5) Realize that explosions are unavoidable and provide a sufficient quantity of explosion valves to relieve the pressure without damage to property or personnel and to prevent the fire that often follows crankcase explosions.

The Service Pipe Line Company decided on the last mentioned course, and an investigation of explosion valves available from the engine manufacturers developed that most were designed for high pressures and the costs were high. We believed that explosion valves for our old engines should open at low pressures to obviate expensive replacement of doors and covers. To avoid high pressures we decided to provide more relief area than the one-half square inch for each cubic foot of crankcase volume recommended by the DEMA. We proceeded, accordingly, with the design of the largest valve that could be applied to the smaller crankcase doors with the idea

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of placing one on each door. A general outline of the explosion relief valve selected is shown in Fig. 1. Two of these valves will be placed on each crankcase door of some of the large engines. Twelve hundred explosion valves will be required to equip all our engines and several pumps. Reports of crankcase explosions that have broken doors without rupturing paper blowout diaphragms prompt placing valves on all crankcase doors. The Bureau of Mines' demonstration of the behavior of explosions in glass tubes with paper covered outlets is additional justification for installing as many explosion relief valves as practical.

Explosion relief valves received with new engines leaked oil when designed to open at 5 psi pressure and to be fully open at 15 psi pressure, so we decided that the valve must cover a blowout gasket that would serve as an oil seal. It has been possible to purchase valves as shown by Fig. 1 for $10 each and to install them economically on our flat steel doors. In some cases it was found less expensive to make new flat steel doors than to fit the valve to cast-iron doors. We would be willing to advise interested persons the source of these valves. It is suggested to the engine builders, also, that this would be an excellent time to standardize at least one part for all diesel engines. In our opinion, these valves are less expensive and more satisfactory than any that they have designed.

We have tested one of these valves by exploding natural gas in a 25 cu ft tank. The test apparatus is illustrated by Fig. 2. The explosion relief valve was tested by attaching it to a $\frac{3}{16}$-in. thick by 26-in. square steel plate, and later to a ¼-in. thick aluminum plate of the same size to simulate our weakest crankcase doors.

Fig. 3 is a facsimile of a typical pressure indicator card obtained while testing a 16:1 air-gas mixture. For purposes of illustration, the abscissa, representing time, has not been transposed to scale. The significance of the pressure-time diagram is that the maximum explosive pressure of 14 psi was reached in approximately 0.15 second and as rapidly returned to zero, after which time the ungasketed relief valve closed and then held a vacuum in the tank for 80 to 90 seconds. The illustration shows how adequately the valve relieved the pressure of the explosion, yet closed rapidly enough to prevent entrance of fresh air, which could sustain a secondary explosion.

During other tests we were able, by varying the mixture and agitation, to obtain maximum pressures of 20 psi. With the relief valve removed and only a 1/64-in. thick by 10½-in. diam paper gasket used to seal the tank, the maximum pressures decreased by about 20 per cent but the safety feature of the reseating valve was lost.

A final test was made using a solid steel plate in place of the paper gasket. Under this condition the maximum pressure was 80 psi, which was relieved by leakage at the door gasket. The center of the ¼-in. thick aluminum door bulged outward about 5 in. and took a permanent set of about 2 in. Had the door been made of cast-iron it doubtless would have shattered.

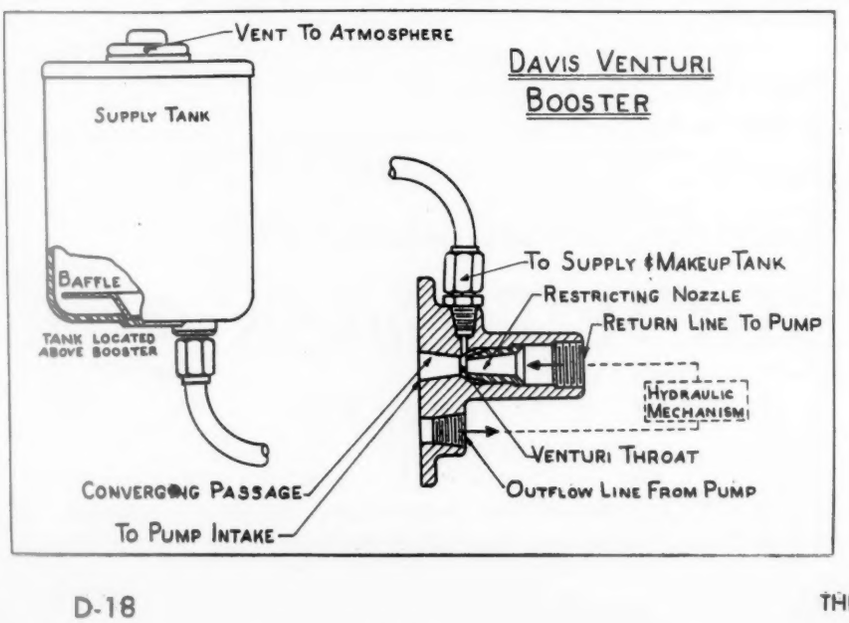
The maximum pressure resulting from an explosion of crankcase vapors and air at standard atmospheric conditions is approximately 100 psi. It would be possible, even on large engines, to build the crankcase to withstand this pressure but the added expense would extend to strengthening exterior parts such as lubricating oil sumps. We believe the practical solution to crankcase explosions remains with appropriate relief valves. * * *

Cavitation Minimized With Pump Booster

An interesting, simple solution to the problem of pressure loss at high speeds in geared, rotary vane, and centrifugal pumps in the form of an input booster without any moving parts has been announced by F. W. Davis, consulting engineer of Waltham, Massachusetts. Practically any geared or vane type pump has a critical speed, above which the theoretical output of the pump exceeds the ability of the intake to supply the necessary liquid. When this speed is exceeded, cavitation—formation of partial vacuums or "pockets" within the pump—occurs.

This cavitation effect causes a drop in output pressure, surges in the flow, pump noise, and impeller or gear and bearing wear.

The new Davis booster pump, by use of a simple venturi to accelerate automatically the input flow at high speeds, gives a steady input of solid fluid to the impeller. It also is said to eliminate efficiency loss due to entrained air.



The pump (see Fig. 1) contains no moving parts. Its operation is dependent upon the difference in pressure between the static head and velocity head in a venturi device. Fluid flowing through the restricting nozzle provides the velocity head that would normally be below atmospheric pressure when entering the intake side of the pump. Connection is made at this point to a supply and make-up tank vented to the atmosphere. Consequently, the fluid in the throat of the venturi is raised to atmsopheric pressure, thereby creating a "boost" or super-charge at the intake side of the pump. By assuring that atmospheric pressure is substantially maintained as the fluid enters the pump, the partial vacuum condition causing cavitation is prevented. Air entrained in the oil is bled from the system through the vent in the supply tank during periods when the pump is stopped.

The booster mechanism may either be added as an accessory or built into the pump. * * *

REMOTELY CONTROLLED STATIONS*

Design of four new stations on Shell's East Line, which operates unattended by push button control over dispatching teletype system.

S. S. SMITH[1]

THE simplest sort of a pipe line station is the single unit pumping through a length of line whose hydraulics approximate the capacity of the pump. This sort of station can be centrifugal, reciprocating, or geared type pump. If the station is attended, about all the controls that are necessary are those required to start and stop the station.

If, instead of a single station, there are a number of stations on the line, the pump capacities in each station must be adjusted to equal the upstream and downstream line conditions; if they are not, the pumps either starve for suction pressure or exceed the capabilities of the downstream line or the pump itself. Thus, as soon as multiple stations are required, control becomes necessary.

In early pipe line techniques, simple single station lines were coupled together and pumped from station tank to station tank, and occasional adjustment of pump throughput served to match capacities between stations. As products lines came into being, and more specifically, multiple products lines became the vogue, the advantages of automatic control became more apparent because with automatic control, throughputs could be maintained higher and cleaner interfaces between adjacent products could be preserved. Thus, for a number of years, product pipe lines have used automatic controls in greater or less degree. The simplest of such controls throttled the discharge of centrifugal pumps, operated bypasses of reciprocating pumps, or regulated the speed of variable speed prime movers driving reciprocating pumps according to the suction pressure of the station. Usually in such stations, secondary or emergency shutdown facilities were provided to stop the pumps in case of excessive discharge pressures as a protection to the line and the motive power equipment. This type of control was the first of the so-called tight line controls, and I believe this was originally used on the old Tuscarora products line system.

In some cases, economic factors dictated the use of diesel or internal-combustion power units, and in the first of these operations the suction pressure functionally controlled the speed of the prime mover, and in some cases the discharge pressure was also tied into the speed control. In these units, air instruments were tied into the governor speed control of the prime mover or were directly tied to the throttles of the internal-combustion engines. Examples of these controls, with which most pipe-liners are completely familiar, were the Great Lakes system and the Phillips Petroleum Company lines.

Where fixed speed electric motor drives were used coupled to multi-staged centrifugal pumps in tight line operations, the centrifugal pumps were throttled to throughputs to match the input from the upstream line and not exceed the pressure limitations of the downstream line. Where products of not widely varying viscosities were pumped, throttling losses in this type of station were not severe. In starting such units with reduced voltage starting and an appreciable time limit involved in bringing the motor and pump up to speed, delayed action in opening the pump discharge valve was required. However, such stations could be built with air controls for throttling based on suction and discharge pressures and with delayed opening of the discharge valve so that starts and stops could be handled automatically from the pressures existent in the main line. If the downstream section of the line was short enough to absorb the "pack" without overloading the pump and motor by excessive throughput, slow opening of the discharge valve was sufficient protection to assure the pump going on the line. Secondary control apparatus consisted of thermal protection of pump bearings, motor bearings, pump case temperatures, and stuffingbox temperatures on pumps together with emergency low pressure suction and high pressure discharge controls, all tied into a shut-down sequence of the pump and motor to assure the station stopping in case of emergency. Such stations could be started and stopped either by pipe line flow rate, controls tied to meters in the station, or by line pressure controls, which were a function of flows through the line. Excellent examples of this type of station are those of Susquehanna Pipe Line Company and Shells' East Line.

Lines that handle one product only and have intermediate stations that should operate whenever the initial station operates can use synchronous motor drives and reciprocating pumps that can be exactly matched to the line characteristics. These stations can start and stop automatically on increase of flow or pressure in the pipe line at the station, and, since they require no differential pressure at the start, involve no particular difficulty in starting. The only necessary controls on such a station are thermal and pressure controls to shut the stations down in the event of emergency and a small bypass stream around the pump controlled by conventional air controls to prevent the pump's throughput exceeding the line's throughput. A good example of this type of station is the Shell Oil Company natural gasoline line station on the Ventura line in California. This station, incidentally, is completely unattended and visited weekly or twice weekly by pipe line maintenance men to check the control equipment.

With the exception of the last station named, all pipe line stations of which the writer has knowledge have attendant operators either on a part-time or full-time basis, and the automatic controls are justified by ease of operation, greater throughput and more accurately controlled pressures than can be achieved by hand. Each type of station has certain limitations and drawbacks and certain advantages. On lines that have approximately fixed pumping pressures by virtue of uniform viscosity or fixed pumping rates by virtue of design fitted to maximum viscosities and penalizing throughputs on low viscosities, the re-

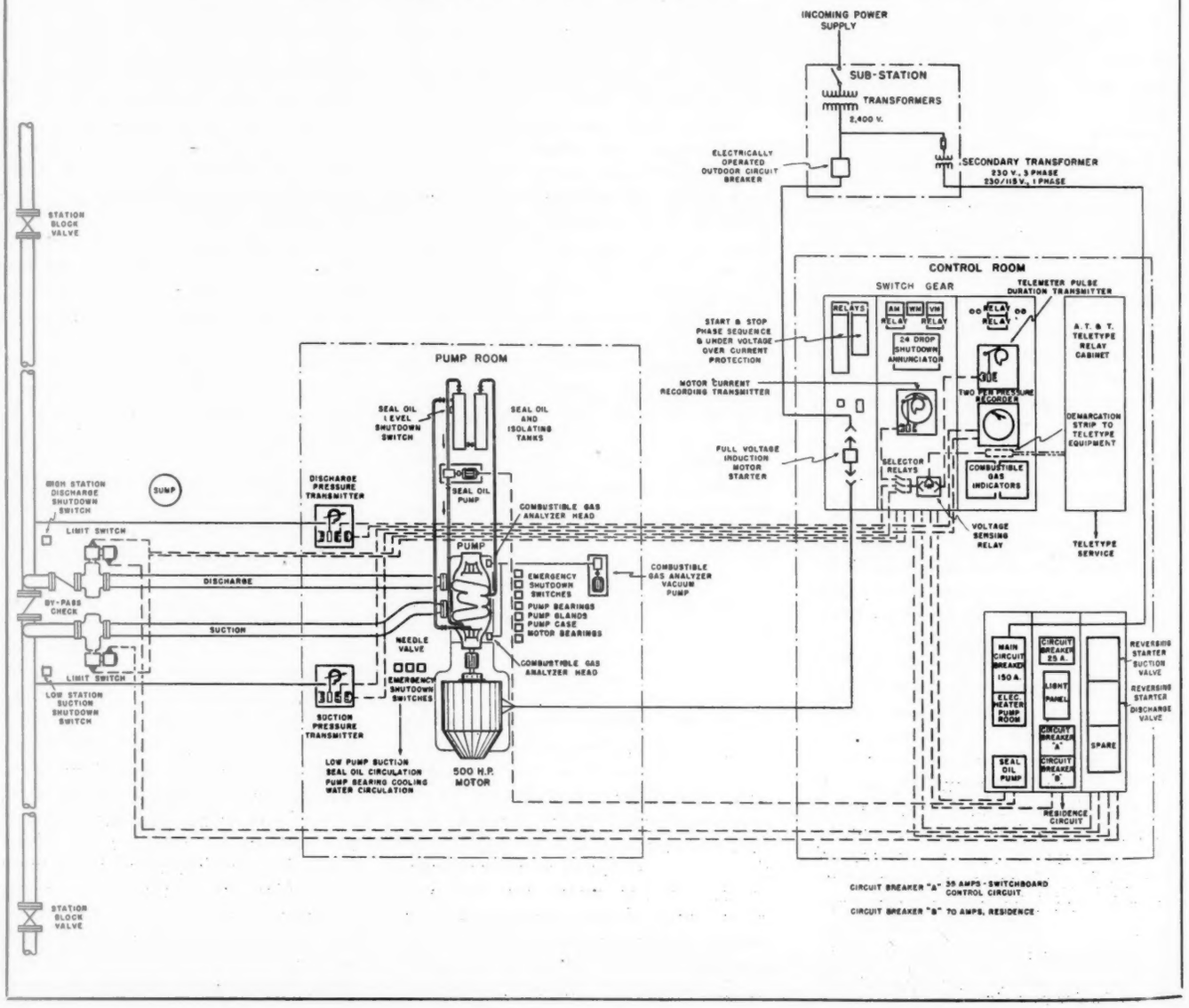
*Presented before American Petroleum Institute Products Pipe Line Technology Conference St. Louis, Missouri, September 11-13, 1950.

[1]Shell Oil Company, Inc.

ciprocating pump has the advantage of higher efficiency and better use of power, but the disadvantage is of pulsating flow with the stresses incident to pressure surges and the difficulties involved in pulsating flow if throughputs are metered. The centrifugal pump with its ease of control and its freedom from pressure surges suffers by comparison to the reciprocator because its power efficiency is appreciably lower. This disadvantage is offset by its ability to handle a greater range of volumes, the fact that it creates greater pressures on higher gravity fluids which require higher pumping pressures, and its low cost of maintenance and repair. Part of its inefficiency is attributable to the very flexibility that is one of its advantages, and it was in an effort to make use of the advantages of the centrifugal and minimize its disadvantages that we recently designed four new stations on our East Line to operate unattended by push button control over our dispatching teletype system. Unlike most pipe line stations, these stations boost only half the normal pipe line working pressure, which in the primary stations is 1200 psi. In the new stations intermediate to the primary stations the pressure boost is 530-600 psi on gasoline and between 650 and 700 psi on fuel oil. The stations have no throttling controls but operate wide open whenever they run. Thus the disadvantage of throttling the centrifugal is set aside, and instead the stations are operated or shut down as the hydraulics of the line require. They provide approximately 5000 bbl a day additional capacity on gasoline, or if run in fuel oil provide the additional boost to match fuel oil rates to gasoline rates in other sections of the line in which the intermediates do not operate. Thus they provide the excess horse-power required for pumping fuel oil at gasoline rates, or alternately provide additional capacity in gasoline. They pump a short section of line, approximately 26 miles, thus the downstream pack required at start constitutes only a few barrels.

The control of the station itself is extremely simple. The basic piping in the station consists of the usual inlet and discharge lines across a check valve in the main line, this unit being a soft-seated Wheatley check. The suction and discharge of the station are taken off stream and downstream from this Wheatley check, and the station block valves are placed in the main line approximately 100 ft upstream and downstream from the station. Thus, if work is required to be done on the check valve in the main line, the main line must be blocked and shut down. The choice here is between building a station on a bypass

FIG. 1. SCHEMATIC DIAGRAM OF TELETYPE CONTROLLED ELECTRIC STATIONS



More Efficient
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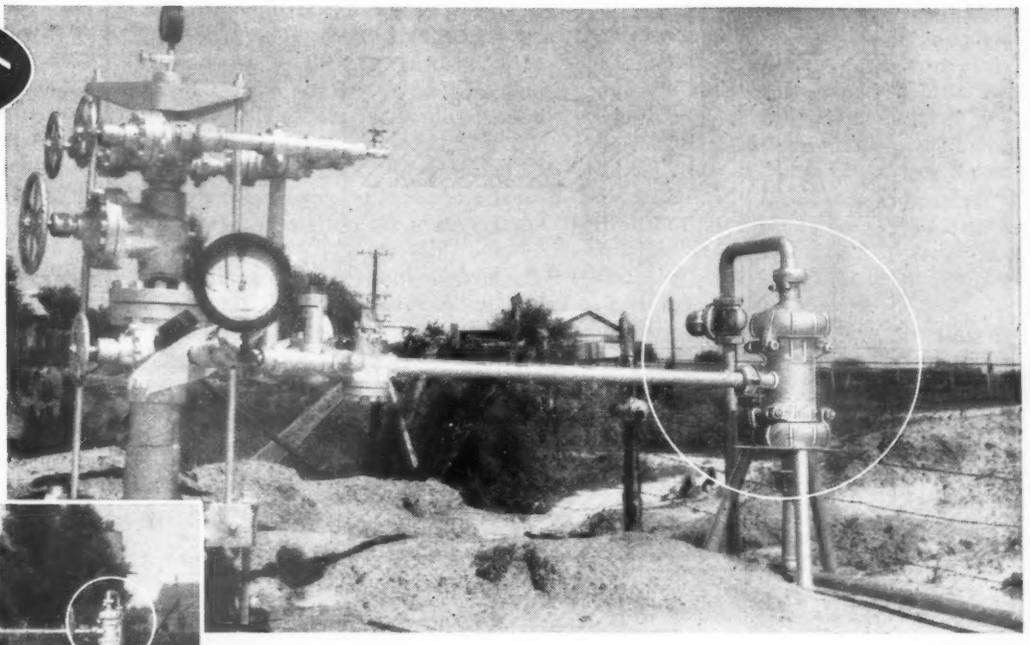
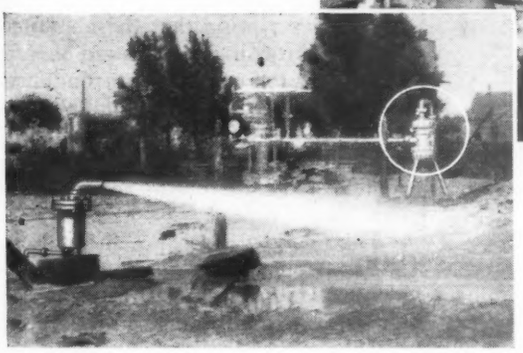
...at the Well





TOP: View of Aerotec Gas Scrubber at the well. The Aerotec unit, in circle, is simple, easy to install and highly efficient.

BOTTOM: Armstrong trap in foreground discharges liquid and solids every 3-4 minutes, from continuous discharge of Aerotec unit in background.

Aerotec Gas Scrubbers are tailored to "at the well" jobs.

These smaller units have proved themselves under severe operating conditions where excessive amounts of liquid, condensate and dust are present in the gas being cleaned.

The 2-year old installation illustrated here precipitates 30 bbls. per MM SCFD of gas. The drips, previously always flooded, were practically dry following installation of this Aerotec Scrubber.

The Aerotec precipitating tube, basis of Aerotec Gas Scrubbers, features a continuous discharge, which in this case was through an Armstrong trap, discharging every 3-4 minutes. This feature eliminates any possibility of sedimentation or clogging up of a sump tank, and the scrubber is always free for continuous operation.

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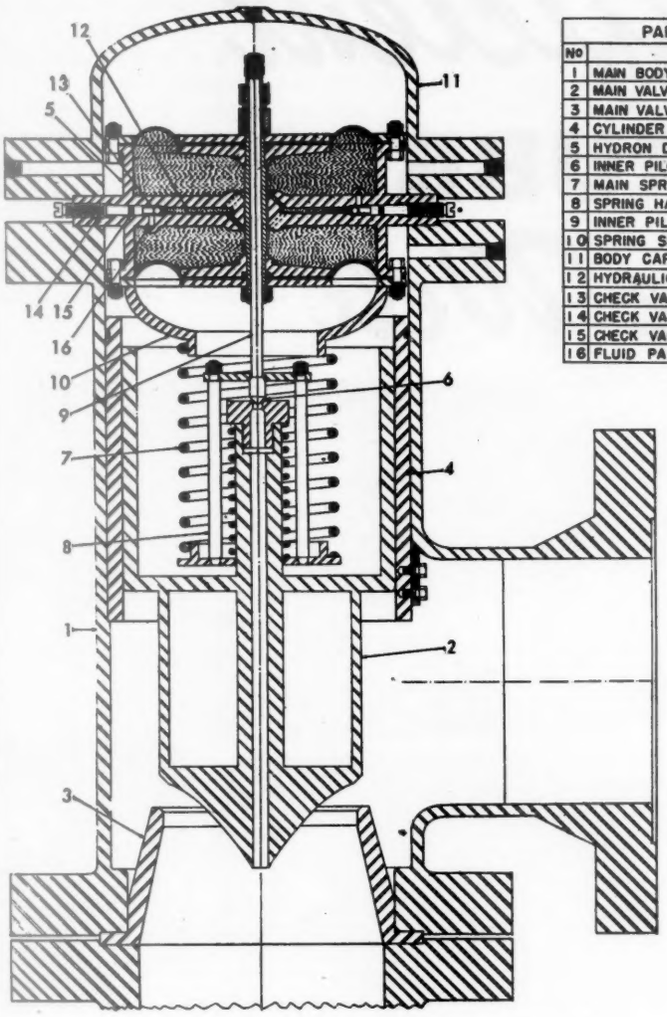


PARTS LIST	
NO	NAME
1	MAIN BODY
2	MAIN VALVE & PISTON ASSEMBLY
3	MAIN VALVE SEAT RING
4	CYLINDER SLEEVE
5	HYDRON DIAPHRAGM UNIT
6	INNER PILOT VALVE
7	MAIN SPRING
8	SPRING HANGER
9	INNER PILOT STEM
10	SPRING SEAT CUP
11	BODY CAP
12	HYDRAULIC FLUID PASSAGE
13	CHECK VALVE
14	CHECK VALVE ADJ. SCREW
15	CHECK VALVE STEM SEAL
16	FLUID PASSAGE CROSS-OVER

FIG. 2. HYDRON VALVE

or across a valve in the main line, and our experience with these bypass checks has been so satisfactory as to justify our placing of the check in the main line. The main station suction and discharge valve are 8-in. WKM gates, motor driven through Philadelphia Gear Works limittorque construction. The sequence in starting the station, either by push button or teletype control, is first a simultaneous start of the seal oil pump, the water circulation pump over the pump bearings, and the opening of the suction valve. The gear drive on the suction valves requires one minute for completion. At completion of suction valve opening, the suction valve limit switch closes the main full voltage motor starter, and the motor-pump combination "pulls in" in 13 to 15 seconds. Through timing relays, 5 seconds after motor start the discharge valve begins to open. The discharge valve requires 1 minute opening time but permits liquid flow approximately 13 seconds after the motor drive starts. Thus, 18 seconds after main motor and pump start the discharge valve opens gradually and the station is fully on the line with balanced suction and discharge pressure in approximately 40 seconds after motor start with no over-range of horsepower or suction or discharge pressure. The shutdown sequence by push button or teletype control opens the main motor starter contactors and starts the closure of both suction and discharge valves simultaneously. Seal oil and water pumps run until the limit switches operate on suction and discharge valve closure one minute after main motor breakers open. The mechanical seals in the pump are double seals operating on lube oil sealed away from the liquid in the pump and the atmosphere outside the pump. The seal oil pump previously mentioned provides approximately 60 psi excess pressure of lube oil over main pump first stage pressure, this differential being provided by piping resistance on the flow of oil from seal oil pump through seals and back to seal oil balance tanks. These two seal oil tanks in turn provide a water-sealed U-tube with lubricating oil on the pump side and product at first stage pressure from the product side. Thus, the seal oil pump provides a constant excess differential pressure of lube oil over product pressure behind the seals. Emergency shutdown equipment consists of Mercoid switches, which shut down and lock out the pump on increasing temperature at motor bearings, motor windings, seals, pump bearing, pump case; also with substandard inlet pressure of product to the pump, excess discharge pressure, low differential pressure on seal oil or water circulation, and in addition to all the foregoing continuous vapor analyzers shut down the pump if inflammable vapor mixtures are present at either the seals or on the pump room floor. This latter feature of protection is provided by continuous Davis Emergency Equipment Company vapor analyzers, which tie into the shutdown sequence of the station. Additionally, any electrical fault in the control system, motor overload, undervoltage and when starting, open phase or reverse phase sequence will cause a station shutdown and lockout. It should be understood in this description that these stations have no throttling control and operate strictly on the balance of throughputs and pressures in the line, the stations being started or shut down at the discretion of the dispatching office by remote control over the teletype system.

The teletype control of the stations is based on the fact that A. T. & T. can provide four selector switching circuits on their long line teletypes. In the case of the stations under discussion, the four selector circuits are used to start the station, report intelligence from the station to the dispatching office, stop the station, and sound an emergency siren to apprise the resident in the station that emergency conditions exist that require his presence. While the switch gear that accomplishes these tie-ins is fairly complex in the aggregate, the individual sequences are quite simple. Taking the functions in the order described, starting of the stations is accomplished by dialing a number on a dial very similar to an ordinary telephone dial and located in the dispatching office. This dialing sets up a code sequence across the teletype circuits to operate the selector system on the receiving teletype, which in turn locks up a relay in the A. T. & T. panel, which energizes a relay in the General Electric switch gear panel, which in turn locks in the starting sequence previously de-

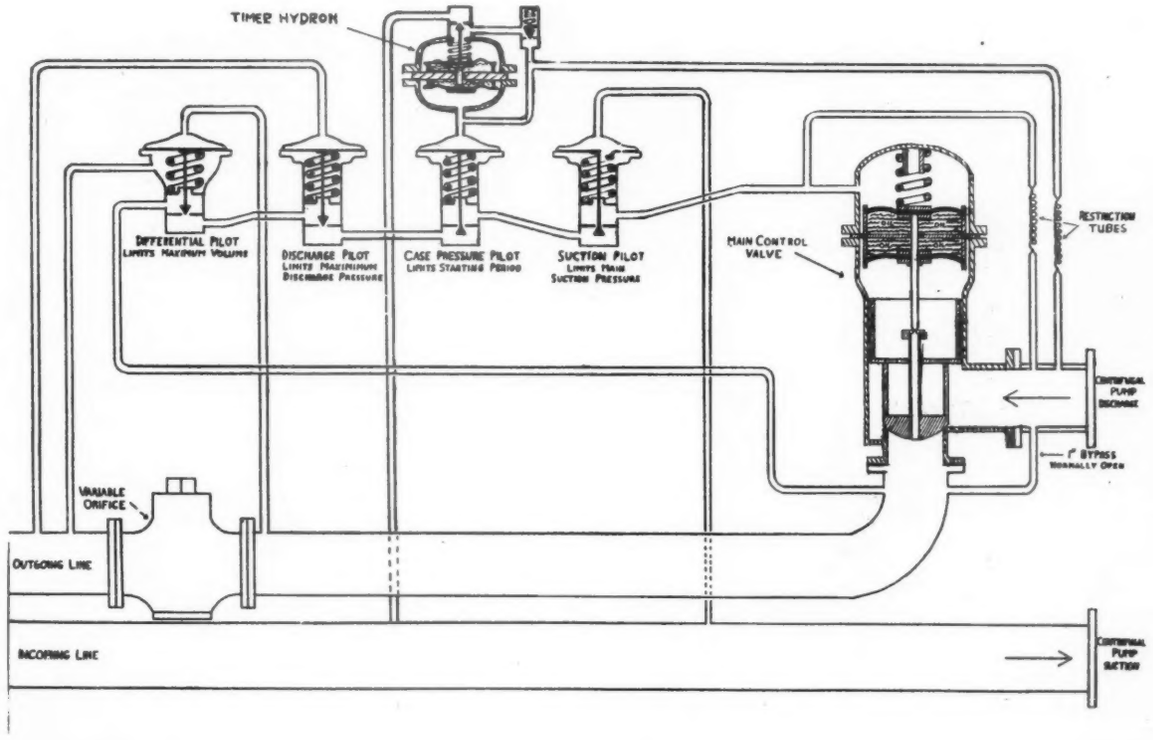
scribed. This impulse having been transmitted, the station comes on the line and assumes its normal pressure balance in the line at the augmented throughput that the station provides. With the station either running or shut down, another number dialed from the New York dispatching office sets up the second selector circuit in the A. T. & T. panel, closing a relay which transfers current to the General Electric switch gear panel, there closing a relay which actuates the reporting sequence. The instrumentation for this reporting sequence, which was provided by Bailey Meter Company, includes a suction pressure transmitter, a discharge pressure transmitter, and a motor current recording transmitter, each in turn coupled to recorders in the control house and telemeter pulse duration transmitter also in the control house. The two pressures and motor current readings are transferred electrically through selector relays to the pulse duration transmitter, which function over a 15-second maximum time interval. A voltage sensing relay closes its contacts whenever the cam-operated magnetic transmitter provides a voltage exceeding that of the measuring magnetic transmitter to which it is connected. The sensing relay contact together with a contact synchronously driven from the cam shaft provides a combination of signals for transmission to the A. T. & T. teletype equipment. These signals are thus converted to a series of repeated letter pulses to the station teletype, which in turn reproduce letters on the teletypewriter in the dispatching office. Thus, in the first 15 seconds after dialing for intelligence, "S's" are transmitted over the teletype in series, each letter "S" representing 20 psi of suction pressure up to 60 letters representing 1200 psi. During the next 15 seconds, "D's" are transmitted on the next line of the teletype representing 20 psi per symbol up to 60 symbols representing 1200 psi. In the third 15-second interval, "A's" are transmitted up to 60 symbols, each representing 2½ amp up to a total of 150 amp. At the end of the 45-second three-line transmission, the station signs its call letters.

Dialing a third number from the dispatching office initiates in the same manner previously described the shutdown sequence, and the shutdown is accomplished in 1 minute after dialing with the station isolated from the line with both suction and discharge valves tightly closed and with the fluid stream in the pipe line going through the across-the-station check. Dialing the fourth number in the dispatching office closes an A. T. & T. relay, in turn closing a relay in the station switchgear to operate the emergency siren for 20 seconds, thus calling out the resident attendant.

A shutdown dialed over the teletype leaves the station free to be re-started at any time in dispatching office discretion. On the other hand, any shutdown of the station brought about by thermal, pressure, or electrical controls locks out the starting sequence so that the station cannot be operated from the teletype until investigated, adjusted, and re-set by the resident attendant. Thus, any under-pressure on the suction, over-pressure on the discharge, any thermal failure, any gas leakage in the station, any electrical surge, voltage failure, or motor overload will shut down the station and not permit it to operate again until the attendant has had a chance to investigate any difficulty and make necessary corrections.

It has been noted that these stations do not throttle. Thus, they overcome one of the major items of inefficiency in constant speed centrifugal pump stations in that the station cannot operate except wide open. It should be noted in this connection that the throt-

FIG. 3. SCHEMATIC DIAGRAM OF PIPE LINE STATION CONTROL SYSTEM



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tling load can be transferred upstream or downstream to the primary station if the dispatching office conducts the operations ineptly. However, since the stations provide differential pumping horsepower to match fuel oil against gasoline in the section where the secondary station does not operate or require that all stations operate on the same product this becomes a remote contingency. It should be noted here that these stations can easily be converted to full hydraulic pressure with throttling controls with a minor addition to the control apparatus. Since the equipment for this control is already developed and in use in other stations, it merits description here.

The basic addition necessary to make a throttling station consist of our so-called hydron valve and its associated pilots. This hydron valve is a single seated 90-deg angle valve, piston actuated and controlled by hydron diaphragm topworks as shown in Fig. 2. It is spring closed with the spring load adjusted to a 5-psi differential pressure across the valve and diaphragms. Upstream fluid pressure is under the hydron topworks diaphragms and regulated pressure is above the diaphragms. As the regulated pressure above the diaphragms is decreased below the upstream pressure, the diaphragms and the controlled needle valve lift, permitting fluid to flow from above the piston valve opening and connected fluid course to downstream of the valve. The release of fluid from above the piston unbalances the piston pressures and lifts the main valve, thus establishing flow. Separate needle and check valves control the rate of fluid passage from one diaphragm chamber to the other, thus permitting both opening and closing rates to be separately adjusted. In practice, the fluid-actuated piston follows the needle valve within thousandths of an inch, and the valve operates without chatter regardless of throttling conditions.

In our normal primary station, 4 pilots are used to control the hydron valve. Closure of any one of the 4 pilots equalizes pressures across the hydron diaphragms and closes the hydron valve. When all 4 pilots are opened, the main hydron is opened. Thus any single pilot can assume control of closure of the hydron. At pump start, as arranged in our primary stations, the hydron is closed because the case pressure pilot is closed. As the pump starts and creates differential pressure, the case pressure pilot remains closed until the timer hydron closes its bypass, builds pressure on the case pressure pilot diaphragm and opens this valve. This in turn permits the opening of the main hydron, which opens slowly on its own adjustments. As flow increases in the pump, a differential pressure builds across the variable orifice throttling the differential pilot and thus controlling throughput on the pump. As the discharge line pressure builds and suction pressure decreases either or both the suction and/or discharge pilots assume control of the hydron valve and regulate the pump throughput to match the line throughput.

In the case of the new stations previously described, which operate with motor-driven valves to accomplish a regulated start, the addition of a hydron valve between the pump and the electrically operated discharge valve, regulated by suction and discharge pressure pilots will provide a completely throttled station, although a differential pressure control pilot, actuated by the differential across an orifice, would need be added if the station over-ranged motor horsepower when pumping heavy oils.

Incidentally, this sort of station can be operated entirely automatically from line pressures or by teletype control as in the case of the present secondary stations and the intelligence reports from the station could include both pump discharge and line pressures so as to indicate to the dispatching office the degree of throttling taking place in the station.

All apparatus covered in these descriptions is presently in use on our East Line and available for inspection at any time. The hydron valve and the hydron timer described are the invention of Norris Plank of the Shell Oil Company and are patented and are available through the Moorlane Company of Tulsa, Oklahoma. This hydron valve can be used for any fluid control that can be controlled by direct pilots. Thus we use the same valve as a flow control, a reducing pressure control, a back pressure control, or in special instances, as a closure valve in main line operations in case of line breaks or excess pressure. We have found this type of control more satisfactory and more stable than air instrument control. Simple proportional pilots are adequate for pipe line control, because the adjustments built into the hydron assembly permit separate adjustment of rate of opening and of closing, thus permitting adjusting that breaks up a cycle hunt by destroying the symmetry of the sine wave response of controls during a cycle. Thus rate action is possible with simple pilots and all the necessary fitting of time response of control to process lag is possible. * * *

These Aldrich 5" Stroke Direct Flow Pumps are:

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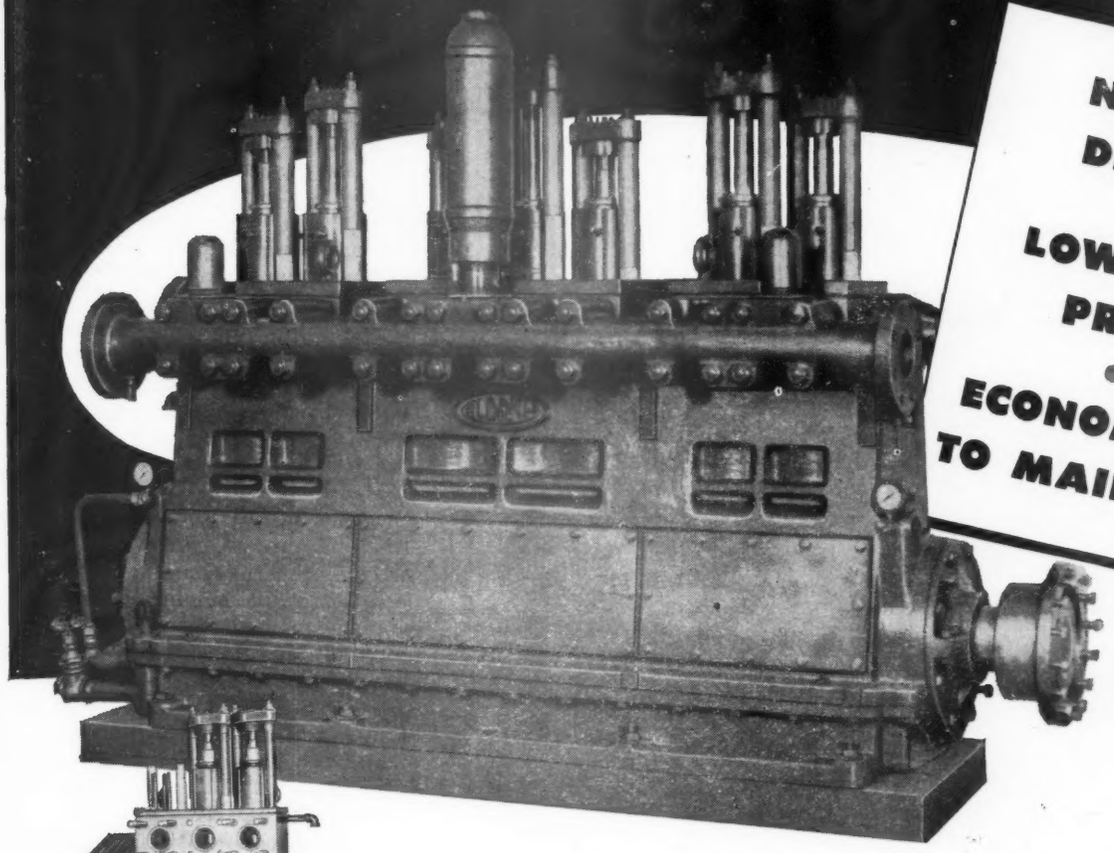
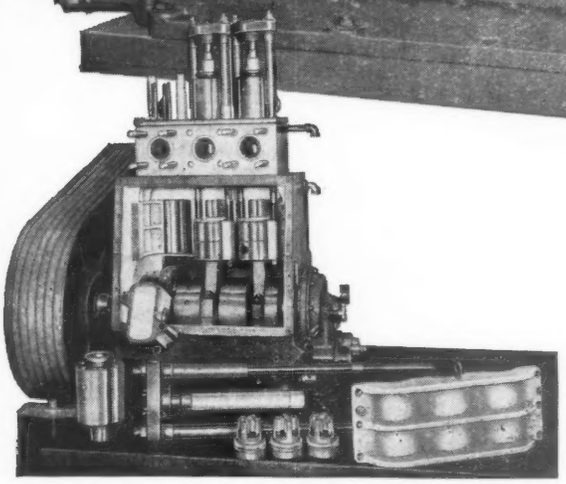


Aldrich 5" Stroke Direct Flow Septuplex Pump



● **A partially dismantled 5" Stroke Direct Flow Triplex Pump. The fluid-end block is bolted to the top of the frame. The suction and discharge manifolds, bolted to the working barrel, serve as clamps to hold the valves in place. To remove valves, it is only necessary to remove the nuts from the holding studs. Manifolds can then be slid on the studs, affording sufficient room to remove and replace valves which are assembled in complete units for ease of handling.**

Making quality construction available at a *new low in price,* Aldrich 5" Stroke Direct Flow Pumps are designed for serviceability and economy of maintenance. Built in 3, 5, 7 and 9 cylinder units, the series ranges from 75 to 275 hp and handles almost all liquids encountered in oil field and petroleum service.

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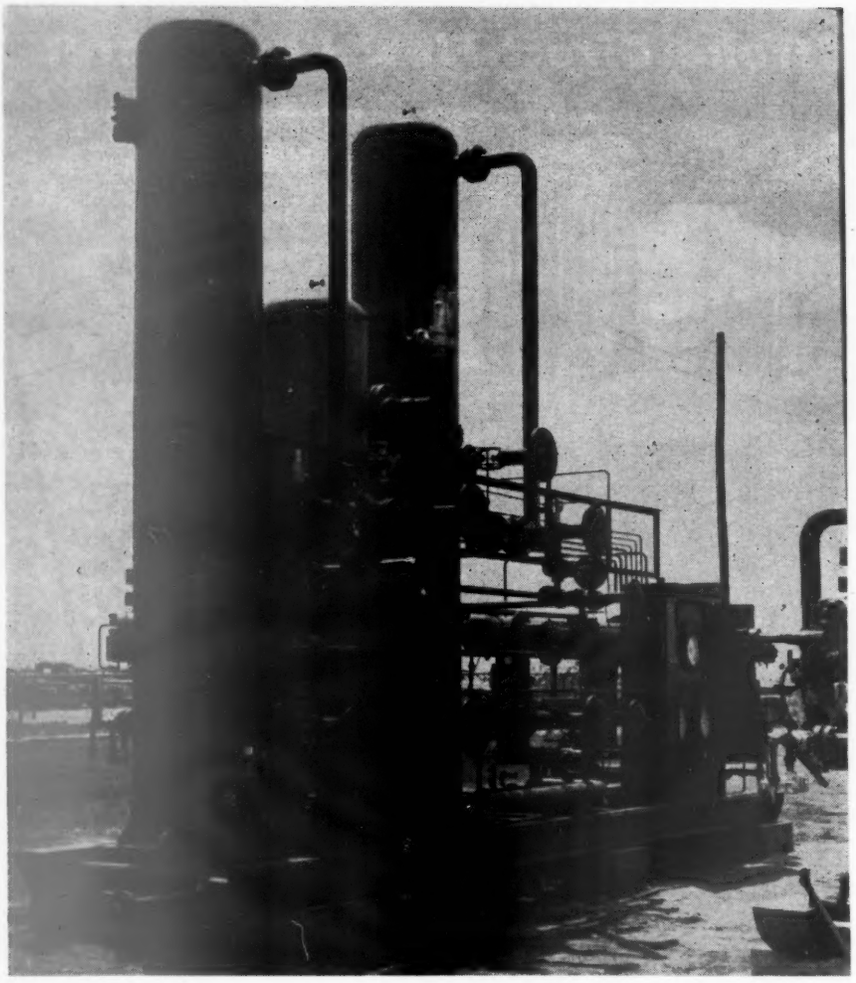


View of packaged dehydration unit, complete with control cubicle and numerous diaphragm motor valves.

Natural Gas Dehydration Units Completely Robotized

Transco dries gas in 15 desiccant-type plants, monitored by pneumatic time-cycle controller.

C. B. AMES†

THE importance of natural gas dehydration prior to its transmission in pipe lines to consumer markets is today well recognized.

Major reasons given for this process of water removal include: (1) Prevents freezing, or the formation of hydrates that can block the line; (2) minimizes corrosion in the line and other operating equipment in contact with the gas, and (3) eliminates the purchase of unsalable water vapors and reduces the horsepower requirements to move gas through the line, resulting in higher operating efficiency.

The Transcontinental Gas Pipe Line Corporation system will transport a portion of 585,000,000 cu ft a day of dehydrated natural gas in its 30-in., 1800-mile long pipe line from the Rio Grande Valley to New York City. To meet this demand, Fish Constructors, Inc., is erecting near the gas fields 15 plants designed to dehydrate the gas to a dew point of 25 F.* These units are of the solid desiccant type, employing florite, and are all identical in design and instrumentation — varying only in size to provide capacities that range from 5,000,000 to 30,000,000 cu ft a day.

Operation of the plants is basically cyclic in nature, with two towers or contactors being used alternately. One tower is kept on stream until its bed of florite desiccant is saturated; then it is switched off to be regenerated while the second tower is simultaneously placed on stream. In the switching process, involving 12 on-off type diaphragm motor valves, the need for reliable automatic control to supplant manual operation is paramount. In addition, temperature and flow must be constantly regulated in the system, if uniformly dried gas of the proper specifications is to be obtained.

General Plant Design

Shown schematically in the accompanying diagram, essential components of the dehydration plant are seen to comprise: (1) two contactors that range in diameter from 2 to 4 ft and in height from 12 to 16½ ft, depending on the plant capacity; (2) a gas-fired heater for regenerating gas, and (3) a regeneration gas cooler where dehydrated gas is heat exchanged with gas from the tower under regeneration. Not shown on the diagram are two additional units of the plant, namely, an inlet separator that removes oil and entrained solids from the incoming wet gas, and a water separator that removes moisture accumulating from the regenerating gas.

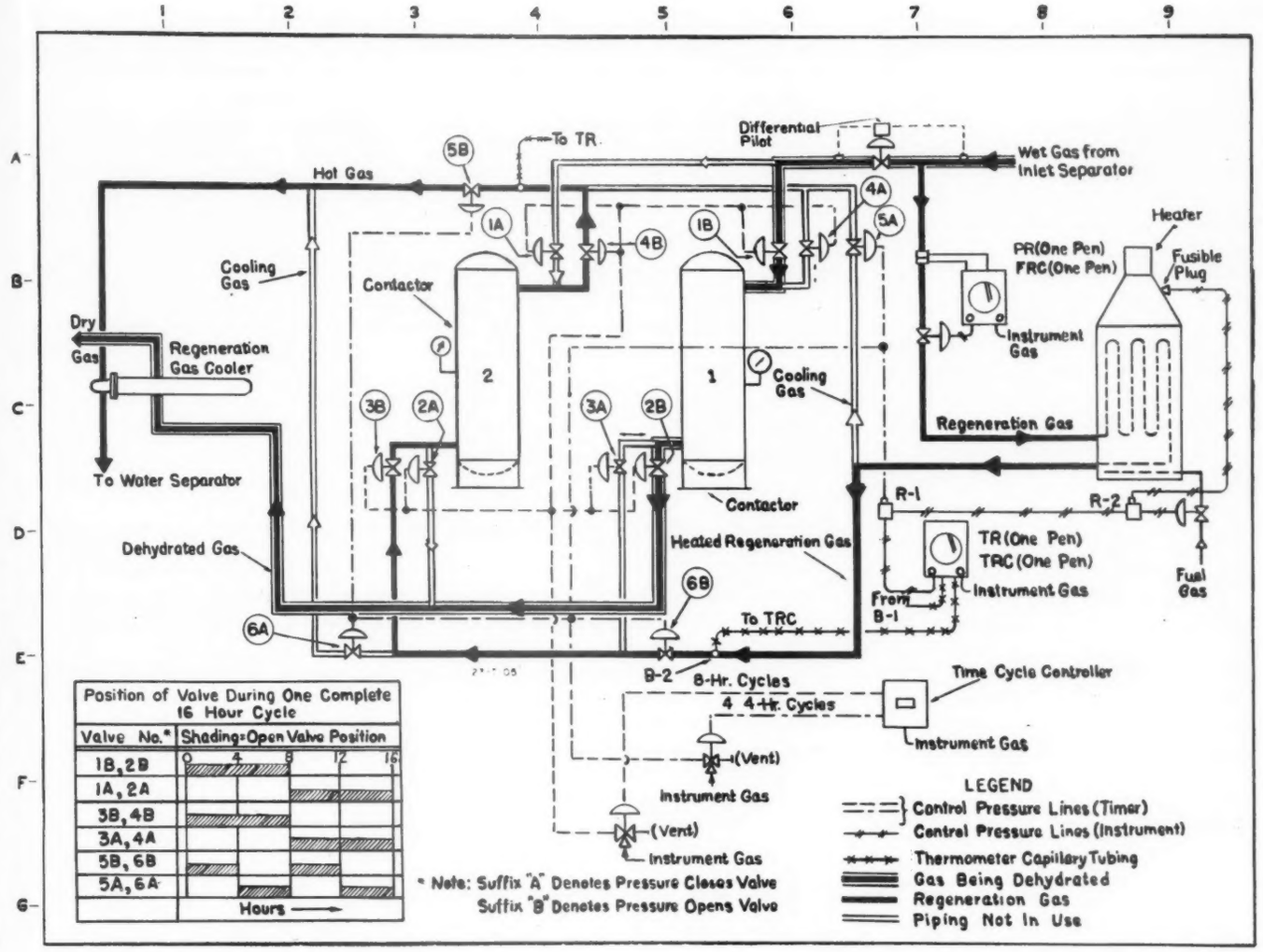
The process, later described in more detail, basically involves a 16-hr operating cycle with each contactor on stream for 8 hr, while the other is being regenerated for 4 hr and cooled for 4 hr. Regeneration is accomplished by a stream of natural gas bypassed off the main line of wet gas and heated to 350 F prior to its passage through the desiccant bed in the contactor. All equipment is operated under a pressure of 800 psi.

One general feature of the instrument system is its complete independence of outside sources for power. All clocks for chart drives and operation

†Vice president Fish Constructors, Inc., Houston, Texas.

*Equivalent to 6 lb of water per 1,000,000 cu ft gas at 800 psi pressure.

EXCLUSIVE



SCHEMATIC FLOW DIAGRAM OF DEHYDRATION SYSTEM AND CONTROLS

of the time-cycle controller are 7-day, spring-driven. Pneumatic controls and fuel gas for the heater in the system are supplied from a line tapped off the dehydrated gas line, the pressure being reduced in two stages from 800 to 25 psi by means of conventional pressure reducing valves.

Time Cycle Control

Operating sequence of the on-off type diaphragm motor valves that serve to switch contactors (coded by number - letter combinations on the diagram) is monitored by a time-cycle controller through two control manifold systems, as shown. This instrument contains two poppet valves operated by cams, which are rotated by means of a 7-day, spring-driven clock.

Connected to the diaphragm motors of separate three-way valves, output gas pressure from the cycle controller is either applied or bled through these poppet valves, thereby governing whether full 25 psi gas pressure or zero pressure is maintained in each of the manifold lines to the diaphragm motor valves.

To follow the cycle of operation in detail, it will be assumed that No. 1 contactor is on stream. Main flow of gas is down through valve 1B, into No. 1 contactor, and out the bottom through valve 2B. Thence, the dehydrated gas flows out of the system, passing through the regeneration gas cooler. This flow continues for 8 hr.

No. 2 contactor is cut off from the main gas stream by valves 1A and 2A, which are closed. To provide heated natural gas for regeneration of this unit, some 10 per cent of the main gas stream is diverted by means of a diaphragm motor valve installed in the main gas stream. This valve is positioned by a "differential pilot," which operates from pressure taps downstream on the main flow line and upstream at the inlet separator; sufficient back pressure is thereby created to provide the bypass flow of gas for regeneration.

Regeneration and Cooling

As shown on the diagram, regenerating gas is flow controlled by a Brown mechanical meter (FRC) through a diaphragm motor valve; the meter also incorporates a pressure spiral and second recording pen for logging the system pressure of about 800 psi. The gas passes through coils in the heater, and then branches into two flow lines: Up toward valve 5A and down toward valve 6B. For the first 4 hr, however, valve 5A is closed, so that flow is only in the lower line through valve 6B, which is open during this same period.

Further, as seen from the chart of valve positions, valve 6A in the lower line is closed, thereby diverting the heated gas up through No. 2 contactor via valve 3B on the bottom inlet line. The latter valve, as well as the valve 4B on the top outlet line of the contactor, is open for the full 8-hr period; and during the first 4 hr permits the flow of heated regenerating gas up through the contactor bed.

Moisture-laden hot gas passes out through valve 5B, being cooled by heat exchange with dehydrated gas in the regeneration gas cooler, as shown in the flow diagram.

During the second half of the 8-hr period, the dryed bed of No. 2 contactor is cooled by the flow of unheated regenerating gas, which passes up through valve 5A, down through the contactor via valves 4B and 3B, and thence through valve 6A on out of the system to the gas cooler.

This operation is initiated by the time-cycle controller, which closes the fuel gas line to the heater, as described, and cuts off the 25 psi gas supply from one manifold line to reverse the positions of the appropriate diaphragm motor valves (see diagram).

Temperature Control

A mercury-filled type Brown thermometer (TR-TRC), range 0 to 500 F, serves to record and control temperature of the regenerating gas, as well as to record on the same chart temperature of the moisture-laden gas leaving the tower. The latter temperature is measured by a stainless steel bulb B-1 inserted in the common line from the two contactors, shown on the diagram.

As hot gas dries out the desiccant, this bulb serves to record the gradual temperature rise and final leveling off when the bed is dry from top to bottom. Thus, it will indicate the drying rate, which can be adjusted by changes in the set point of flow controller FRC.

For temperature control of the regenerating gas, a second bulb B-2 is situated in the heater outlet line ahead of valve 6B, as shown. A narrow band proportional control unit in the Brown recorder throttles control gas, which normally passes directly to the fuel gas control valve through pneumatic relays R-1 and R-2 (Honeywell Type RO48A). In accordance with the temperature set point of TRC, the fuel valve is thus positioned to maintain a constant temperature of regenerating gas.

Pneumatic relay R-1 serves to cut off control gas from TRC and thereby close the fuel gas valve at the end of 4-hr regeneration period. This is accomplished by connection of the relay pilot in the impulse line from the time-cycle controller, as shown. Pneumatic relay R-2 also serves to cut off control gas from TRC through the action of a fusible plug that is installed to melt at 1100 to 1125 F, thus venting instrument gas pressure in the event of excessive heater stack temperature. * * *

FPC Postpones Phillips Hearing to January 8

The Federal Power Commission has further postponed until January 8, 1951, the hearing previously scheduled to begin October 9 in Bartlesville, Oklahoma, in the proceeding involving FPC's investigation of Phillips Petroleum Companys' natural gas operations. Motions for continuance of hearing were filed by Phillips, the Corporation Commission of Oklahoma, and the Railroad Commission of Texas. Phillips had asked a continuance for the duration of the present war emergency or at least until some date after January 1, 1951.

Previously, on August 11, Phillips asked for a continuance of the hearing, then set for September 11, until January 2, 1951, on the ground that its principal witnesses are key employees of vital importance in the production of war materials. The commission subsequently granted the postponement until October 9.

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Army surplus pontoons (center) supported a wagon drill for drilling holes in the river bottom. Here charges of explosives are being tamped into the holes preparatory to blasting.

SWEAT FELL ON ALABAMA

A PIPE LINE 30-in. in diameter goes through the solid granite river bed of the Tallapoosa near Wadley, Alabama.

It is part of Transcontinental Gas Pipe Line Corporation's $235,000,000 line from the lower Rio Grande Valley ultimately to deliver 500,000,000 cu ft of natural gas daily to metropolitan New York City.

The job of putting this line under the Tallapoosa was the toughest encountered by Midwestern Constructors, Inc., along the two sections of pipe line they built through Alabama and Georgia.

Blasting a channel 5 ft deep across the Tallapoosa's 318-ft width required more than 5000 lb of explosives. Swollen waters and swift current hampered drilling, slowed the digging out of shattered rock, threatened the positioning of tons of heavy steel pipe.

Standard equipment on Midwestern's heavy duty bulldozers and earth moving machinery, Jones & Laughlin Steel Corporation's wire rope played a vital role throughout the operation.

The right-of-way approach to the river on the east bank is a 25 per cent grade. The west bank approach is a 7 per cent slope. Banks were cut to the river edge by the right-of-way crew.

At its height, the explosion of 3500 lb of high explosive in the river bottom of the Tallapoosa reached nearly 1000 ft.

Wire rope cables were strung across the river to support and anchor equipment against the river current. The crossing operation to put the 30-in. pipe line a minimum of 2 ft under the river bottom was underway.

Drilling was begun off the west bank. Suspended from a sideboom tractor, a wagon drill consisting of two air hammers on a yoke, began pounding down holes 2 in. in diameter, 5 ft from center-to-center, in the river bottom.

With 62 holes drilled, the river began to rise and threatened to fill the holes unless longer casing was installed. Instead a test shoot was made to determine the nature of the bottom and the adequacy of the 2-in. holes.

In the explosion 1240 lb of 60 per cent high velocity gelatin dynamite was used. Bulldozers, a back hoe, and a clamshell, cleaned out the blasted rock. Preliminary sounding indicated the shoot successfully blew out a trench 5 ft deep in the rock for a short section.

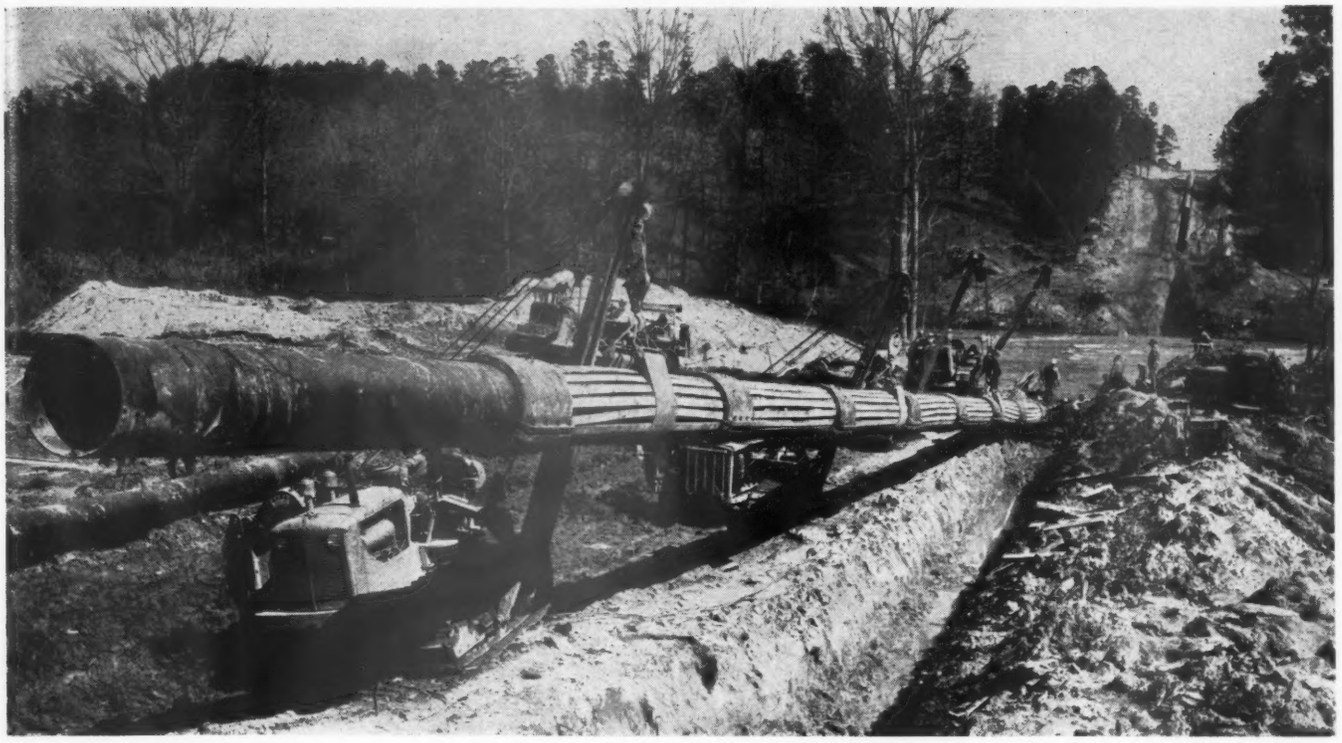
After the Tallapoosa river bottom was dynamited, bulldozers helped to clear out blasted rock. Working with water sometimes over the floor, moving boulders weighing several tons, heavy equipment received rugged usage.

Water along west bank of river was 3 to 4 ft deep for nearly 150 ft out from shore. The rest of the width varied down to 8 ft deep. Drilling operations were then resumed in the shallower section of the river. To drill the deeper section, a water well drill that made holes 6-in. in diameter was used.

During drilling, the well drill was floated on two Army surplus pontoons used during the war for portable bridges. The pontoons, inflated by air compressor, were secured to wire rope anchor cables suspended across the river. Additional pontoons were used to carry out other phases of the operation.

For passenger traffic back and forth across the river, a wooden row boat was put in service during one phase.

Wire rope from a winch tractor on the east bank, pulls the first two sections of pipe line into the river as side boom tractors on the opposite bank carry the end to avoid damaging the coating. The clamshell boom in the left foreground is used for directional control.



Four side-boom tractors guide pipe line to avoid damaging the special coating. Here the line is ready for the second "pull" consisting of a total of 240 ft of 30-in. pipe.

Three different times the boat capsized in swift current. Once Bruce Williams, foreman, and another crew member were swept down river. They were saved only after a long struggle to reach shore, and narrowly escaped the casualty list. The boat was lost.

While sounding the river bottom, engineers William Daniels and Ned Chandler were in a boat that turned over. They leaped for the wire rope life lines and pulled themselves hand-over-hand some 100 ft to the shore in another close escape.

Ultimately 38 holes 6-in. in diameter and 70 holes 2-in. in diameter had been drilled. It was estimated that enough explosive could be packed into them to complete the 5-ft trench across the river.

In all, 3500 lb of explosives were used for this one shoot. Holes were cleaned out by air jet. Into the large holes went 5-in. by 24-in. cans of Nitramon and Nitramex. In the smaller holes, 60 per cent high-velocity gelatin dynamite was used. The entire charge was connected with Primacord.

At 9:46 a.m. the charge was detonated. The explosion blew water, rock, and steel pipe casing nearly 1000 ft into the air.

Again bulldozers, back hoe, and clamshell began to clean out loose rock and heavy boulders from the trench in the river bottom. Sounding disclosed one or two locations that required additional blasting. More than 500 lb of explosives were used at various points in "adobe" charges on the bottom to complete the trench.

Meanwhile the pipe bending machine was in operation, giving the proper curve to the pipe to fit the contour of the granite river bottom. Because of U-shaped slopes about 75 ft from the east bank, two bends were required in the river sections.

Huge pipe was further processed in a cleaning and priming machine, and a coating and wrapping machine. The exterior was coated twice with Barretts pipe line enamel, Type B coating. The first coat was covered with glass wrapper and the second coat with felt. In the river bottom, the 2-ft covering over the top of the pipe will give additional protection against corrosion.

Continuous heavy rains caused the river to rise again and held up the coating operation. Rains were followed by a severe cold spell. Finally the pipe line was ready to be pulled across the river.

Thirty-foot lengths of pipe had been welded end-to-end into three sections. Two sections were 120 ft long and one section was 150 ft long. On the river end of the first section of pipe, a "bull plug" was welded across the pipe end sealing it. Two holes were cut in the bull plug and a piece of 2-in. was inserted and welded in position. Around the pipe was fastened a 7/8-in. J&L wire rope cable, capable of withstanding loads up to 32 tons.

The cable extended across the river to the drum on a winch tractor anchored to the hillside. At 8:50 a.m. the tractor began pulling the first section of pipe into the water. Four side-boom tractors carrying the pipe in wire rope supported slings, guided the pipe into the river, preventing it from scraping on the river bank. Because of its sealed end, the pipe was bouyant in the water and the weight on the cable pulling it across the river diminished as the crossing progressed.

When the first section was in the water, the second section was welded to the end of it, and a second pull was made until both were in the water. Then the third section was welded to the end of the second section, and the entire 390-ft length was moved into final position. It was nested into the trench prepared for it, where river deposit will cover it over.

The pipe ends were welded to the approaching sections of the main line already in the ground, and another gap in the pipe line was closed—one more step on the long and difficult pipe line trail to New York City.

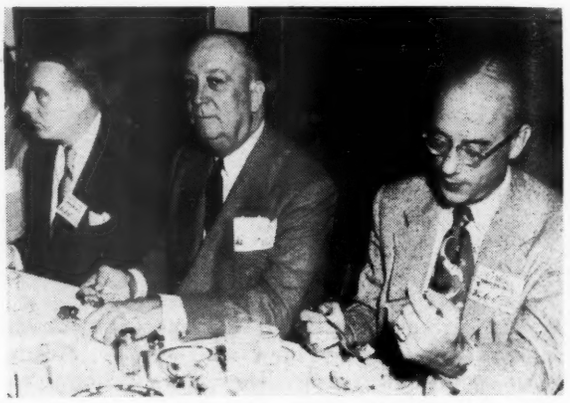
Superintendent on the job for Midwestern was Clyde Peters, a veteran of 21 years' experience in pipe line construction. He has worked on lines in 32 different states. During World War II, he spent 15 months in the China-Burma-India theater with the General Service Engineers.

The sections of pipe line completed by Midwestern were subcontracted from Fish Engineering Corporation, Houston, Texas. ★ ★ ★

Pictorial

J. L. Burke, president of Service Pipe Line Company; J. L. Latimer, president of Magnolia Pipe Line Company and Magnolia Petroleum Company; L. H. True, vice president and general manager of Magnolia Pipe Line Company, and Jack Vickrey, attorney, Magnolia Pipe Line Company.

Building Dedication. Amid much pomp and circumstance, Service Pipe Line Company recently dedicated a new office building in Tulsa, Oklahoma, the only pipe line company to have a building for its exclusive occupancy. The ceremonies were attended by important personages in the transportation industry, pipe line and otherwise. Views of the building and informal pictures of some of those present are shown.



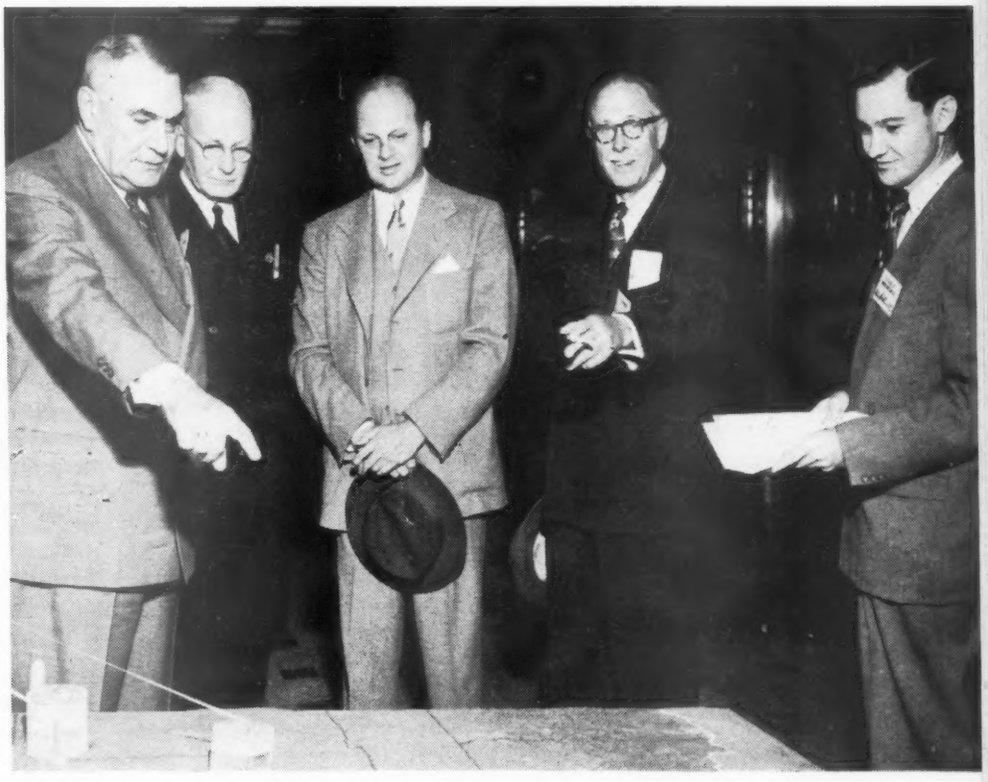
Cecil L. Hunt, general counsel, Service Pipe Line; O. F. Moore, vice president, Ohio Oil, and R. J. "Bob" Andress, director in charge of traffic, Service Pipe Line, at luncheon at the Mayo Hotel.

The Tulsa Chapter of the Petroleum Motor Transport Association attended in a body with Dal Clark, superintendent of motor transport for the pipe line firm, as host. Front row, are: Clark, Ken Miller, Clark's assistant; H. E. Thompson, Stanolind Oil and Gas; J. D. Ward, Tide Water Associated; Joe Huitt, Deep Rock Oil. Second row: H. W. Bray, Mid-Continent Petroleum; C. E. Jackson, Mid-Continent; D. L. Megill, Oklahoma Natural Gas; E. L. Taylor, British-American; Rex Stiner, Mid-Continent; J. M. Green, Olson Drilling. Back row: H. J. (Navy) Chambers and B .W. Bickel, both of ONG; Joe Pulliam, British-American; T. M. Neal, Amerada; E. L. Taylor, British-American, and Harvey L. Bryant, Pure Oil.

H. P. Bradley, safety supervisor for Service Pipe Line Company, (right pointing) is shown conducting a group of truck, rail, airline, pipe line, and waterway executives through the building.

Gordon C. Locke, Washington, National Committee for Pipe Lines; George Douglas, Washington, chief of the Interstate Commerce Commission's bureau of valuations; F. O. Prior, Chicago, vice president in charge of production, Standard (Indiana); J. Paul Kelley, ICC pipe line expert; John E. Boice, pipe line adviser to PAD.

Russell S. Rhoades, manager of the Tulsa Chamber of Commerce; W. G. Skelly, dean of oil men and head of Skelly Oil; Elmo Thompson, vice president of Tulsa's First National Bank; Seth Herndon, executive vice president, Skelly Oil, and J. A. Owens, supervisor of property and valuation, Service Pipe Line, in the employees' coffee lounge.



Frank C. Rathje, president of the Transportation Association of America and the Chicago City National Bank and Trust Company; Thomas J. Nugent of the First National Bank of Chicago; R. E. Nelson, Jr., general manager of crude oil supply and products lines, Standard (Indiana); F. O. Prior, vice president, and board member, Standard (Indiana), and E. E. Hurley, Service Pipe Line.

QUICK ACCEPTANCE *in the gas transmission field!*

Pipe line companies purchase over 109 Worthington uniflo design TYPE UTC-16 angle gas engine compressors

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- **All parts were carbon-free,** demonstrating the marked superiority of Worthington uniflo scavenging over conventional loop scavenging for reducing wear.
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- Rings showed minimum wear, with tool marks still visible.
- Bearings were all in perfect condition.

A Success From The Start

Shop tests had already proved TYPE UTC-16's more thorough scavenging, and perfect combustion. Now, this far more conclusive field test proved the ability to assure these benefits over a long, trouble-free service life. And a steadily growing list of purchasers has established TYPE UTC-16 as a real history-maker in the development of more efficient, more economical gas transmission.

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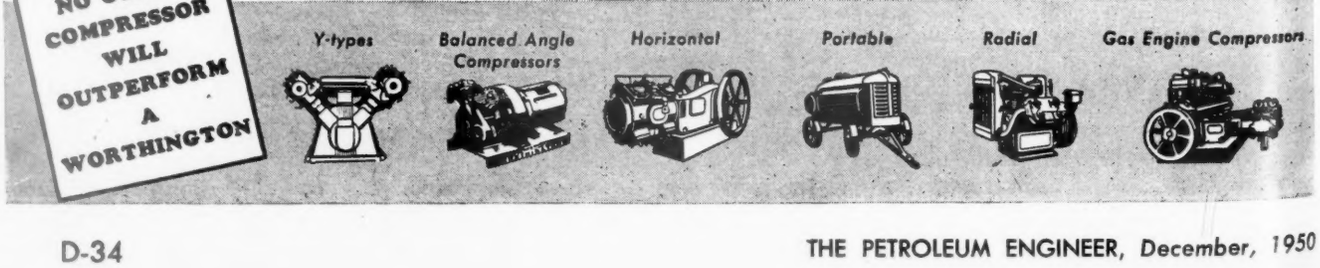

P 615.635.

Developments in Coatings and Cathodic Protection*

Improvements in external corrosion control of underground pipe and possibilities of further reduction of corrosion losses.

CARLTON L. GOODWIN†

CORROSION prevention has become an important part in lowering pipe line maintenance expense and in improving continuity of operation.

Those keeping up with improvements in corrosion control may take advantage of improvements to reduce further corrosion losses.

Past developments reported before the American Petroleum Institute, substantiated by experience, can be condensed into a few basic statements.

a. Coating and cathodic protection extend the life of pipe subject to external corrosion.

b. Coating alone has a limited effective life—this limit depending on conditions.

c. Cathodic protection has been effective on bare pipe, but the cost of maintaining protection over a long period of time may be excessive.

d. Effective coatings supplemented with cathodic protection have been most successful in arresting and in preventing corrosion losses, with low operating cost for cathodic-protection current.

Developments In Coatings

The trend in oil pipe lines is toward the use of those materials that have, and retain, good electrical resistance underground and the lowest solubility in crude oil or crude oil products.

These limitations presently confine good coatings to hot-applied coal-tar enamels. Field test data taken on portions of a recently completed 18-in. crude oil pipe line coated by a traveling type machine, which line was coated with 180 F coal-tar enamel to an average thickness of $\frac{3}{32}$ in. and reinforced with an 0.015-in. glass mat and wrapped with 15-lb coal-tar-impregnated asbestos felt, showed coating resistance between 1 to 30 megohms per square foot. This test was made according to a recognized method of impressing current on the pipe, and of noting the increase in pipe-to-soil potentials with reference to copper—copper-sulfate electrodes at the extremities and at intervals along the coated section under test. The backfill around the pipe was well settled after several heavy rains. With a holiday detector immediately behind the coating machine, the coating was inspected 100 per cent, and holidays were patched before the pipe had been cradled directly into a well padded ditch. The pipe was padded further, before backfilling, if rocky terrain had to be traversed.

Multi-layer glass-mat-reinforced coal-tar coating—supplemented with 18-in.-width abrasion pads on 5-ft centers made of 5- to 10-layer glass mat saturated with coal tar—has proved to be very satisfactory for rocky stream and river crossings as well as for pulling through long highway and railroad casings. Three layers have been applied successfully with traveling type coating machines. Tests, after sections of this type of coated 18-in. pipe had been pulled through a rough ditch, indicate overall coating resistance in excess of 1 megohm per sq ft. This means that, in most of these cases, less than 2 milliamperes of current per 1000 ft will be required to put this pipe under 100 per cent protection.

Other products under test during the last few years have disclosed two new products having possibilities as follows:

a. A product composed principally of reclaimed synthetic rubber has remained effective as an electrical insulator for more than three years buried in a highly corrosive sour crude oil-soaked soil. In the present commercially available form as a cold-applied mastic, it is very convenient to apply to valves, flanges, buried manifolds, and short sections of pipe. Development into a form that contains reinforcing material, such as a glass matting, and which can be applied to pipe lines with a traveling machine over the ditch and immediately lowered into the ditch, should result in lower costs of application and in a long life for the coating.

b. An enamel produced by reacting asphalt and resinous materials has been effective for more than two years under the same conditions, whereas normal asphalt enamels failed within three months.

Methods and equipment have been developed for applying concrete over coated pipe. One process uses an extrusion principle; the other is similar to "gunite" application, but it is applied mechanically instead of by air. This concrete-coating system should have possibilities for weighting down larger diameter pipe in streams, or may be advantageous in protecting against mechanical damage of coating underneath.

Concrete alone as a coating material has proved ineffective and uneconomical in locations most favorable for concrete stability, i.e., in sand and sandy soil near the Great Lakes.

Wrapping materials, which serve as reinforcing or as a soil shield. have seen some improvements; and others, in the experimental stage, appear to offer promising possibilities.

Glass-fiber matting serves only as a reinforcing material for impeding cold flow in bitumen coating, and it does not have the essential properties as a shield against soil stress. Glass-fiber matting impregnated with bitumen (asphalt) is being marketed as a soil-stress shield, but its effectiveness can be determined only after it has been in service.

Asbestos felt is presently recognized as a preferable soil-stress shield. A glass-fiber mat, impregnated with a synthetic rubber of known underground stability, is in the development stage; it offers promise as a soil-stress shield.

There is a definite need for a lighter soil-stress shield wrapper for use on traveling type coating machines, where glass-mat reinforcing and an outside shield are applied. Wrapper of lighter weight would allow greater lengths in rolls—thus giving more distance of travel per roll and resulting in better economy of application; it would also reduce the amount of weight to be transported or handled. For example:

Each time that a traveling type coating machine, which applies hot enamel reinforced with a glass mat, is stopped for a few minutes, 2 ft to 5 ft of hot-applied coating are without glass-mat

*Paper presented before American Petroleum Institute, Los Angeles, California, November 14, 1950.

†Portland Pipe Line Company, Portland, Maine.

reinforcement, and the wrapper does not bond to the coating. In the case of 400-ft rolls of 18-in. felt and glass mat used on 18-in. pipe, this amounts to 2 to 5 per cent of the length of the pipe lacking these essential materials.

Use of the Pearson holiday detector to locate coating defects after pipe burial has contributed much toward coating improvement. Detection of defects and their excavation have revealed the causes in most cases, and have made possible means for the elimination of their recurrence.

Cathodic Protection

Direct-current supply at low voltages is required for the application of cathodic protection.

Various methods have been tried during the past for providing current; these include galvanic anodes, motor- or engine-driven generators, wind-driven generators, thermal generators, and rectifiers.

The principal sources of protective current now in use originate from galvanic anodes and rectifiers.

Dry-type rectifiers have proved most successful and dependable. The copper-oxide elements were the most popular in use before the exhaustion of the copper supply suitable for their manufacture.

Rectifiers require proper cooling, protection from moisture or water, and exclusion of insects.

Housings for outside mounting units must be carefully designed in order to fill the foregoing requirements.

Improvements in Rectifiers

Improvements have been made by immersing the entire rectifier unit in oil; this results in better cooling and in more effective exclusion of moisture and insects. Oil-immersed units also have the advantage of greater safety in locations where fire hazards exist, and they are little affected by a corrosive atmosphere.

Larger rectifier units are available for three-phase circuit operation; these give higher efficiencies.

Rectifier Ground Beds

The ground bed, or the anodes and connecting cables required for a rectifier installation often cost more than the rectifier unit; the subsequent cost of maintaining a ground bed depends upon the type of anodes installed.

Anodes of iron or iron alloys are consumed at a theoretical rate of approximately 20 lb per amp per year. Carbon or graphite anodes for an equivalent current time have a theoretical loss rate of only 2 lb.

The increasing price of iron has diminished the use of scrap-iron materials for ground beds; hence carbon or graphite anodes are used more extensively.

Carbon anodes are subject to rapid disintegration under some conditions —especially when, during operation, chlorine is evolved at the anode surface. This disintegration results from segregation of the carbon particles in the anode; it does not result from decomposition of the carbon. Graphite anodes are more stable in such environments. With respect to rectifier ground beds, it is important that individual carbon or graphite anodes be placed properly in relation to one another, and to the pipe line, if efficient and economical operation is to be obtained. The type of soil, as well as uniform adequate moisture content, is also important.

Crushed coke (coal coke), known as "coke breeze," can be used to advantage with carbon or graphite anodes, i.e., as a backfill in the space between the anode and the soil surface. Such an installation helps to lower ground-bed resistance, and it extends the life of the anode. Bored holes for this type of installation should not exceed 24 in. in diameter, and the coke breeze should be tamped well to give the best results.

Petroleum coke is not suitable for use around anodes unless it has been heated to a temperature above 1800 to 2000 F in an oxygen-free retort.

Development work is under way to provide a ceramic container for placement in bored anode holes; this container will allow anode replacement or addition of coke breeze without excavation, thus minimizing maintenance cost for ground beds designed for 20-year operation or longer.

Galvanic Anode Installations

Galvanic anodes are limited to those metals that cause current flow when they are connected to the pipe, and when this current flow consumes the anode.

The practical materials available for anodes are zinc, aluminum, and magnesium.

Zinc does not cause as much current flow as the other two metals under equivalent conditions; however, it has the advantage of high efficiency in current delivered per unit of metal consumed, and this metal suffers little or no loss in the soil when disconnected from the steel pipe.

Aluminum anodes require special backfill, and some of the chemicals necessary for the maintenance of operation require caution in handling and installing. The present trend does not indicate extensive use of this metal for galvanic anodes.

Magnesium metal—particularly one type of magnesium alloy—is most generally in use for galvanic anodes for the protection of underground pipe. Magnesium continues to be consumed in most soils whether connected or disconnected to buried steel pipe; hence it is advantageous to operate such anodes at a relatively high-current output in order to obtain better efficiency.

New improvements in galvanic anode installations include:

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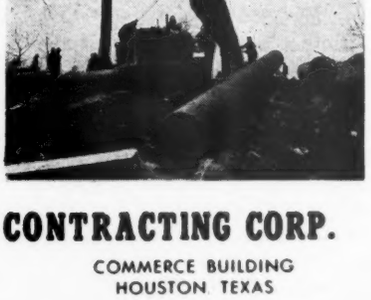

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OKlahoma CONTRACTING CORP.
MERCANTILE BANK BUILDING
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1. Anodes in packaged units; the anode and backfill are supplied in paper bags ready for installation in the soil.

2. Small portable boring and trenching equipment adaptable to small tractors or jeeps; this minimizes hand labor.

3. Thermite welding of connections to the pipe; this is accomplished with equipment that weighs only a few pounds. Less excavation is required than with arc-welding or soldering.

4. Preliminary tests for the determination of, *a*, the most desirable spacing; *b*, the distance from the pipe line; *c*, the depth to place the anode for uniformly low-resistance soil; and, *d*, control of output of each anode: These will tend to insure more efficient installations.

Lightning Protection

Attention is invited to the long-standing practice of driving copper-clad rods that serve to ground electrical equipment so as to take care of surge or fault current.

These large areas of exposed copper are connected, through motor frames and other equipment, in such a way as to expose all buried conduit, cable sheaths, and underground pipe in the vicinity so that those will become anode surfaces.

This practice has contributed in no small way to pipe failures around pump stations and other structures. This source of destruction can be eliminated by substituting zinc ground rods for copper rods, thus providing beds that will decrease in resistance with time and will provide some degree of cathodic protection to conduits, sheaths, and pipe. Such ground beds should be checked periodically to determine the need for replacement because of their being consumed by supplying cathodic protection current.

Further advantages are gained when cathodic protection current is supplied for station piping from rectifiers, or from other sources, because the zinc ground bed will not permit current flow from the soil to the zinc surface until all iron surfaces are well above the normal protective voltage level.

Other Measures

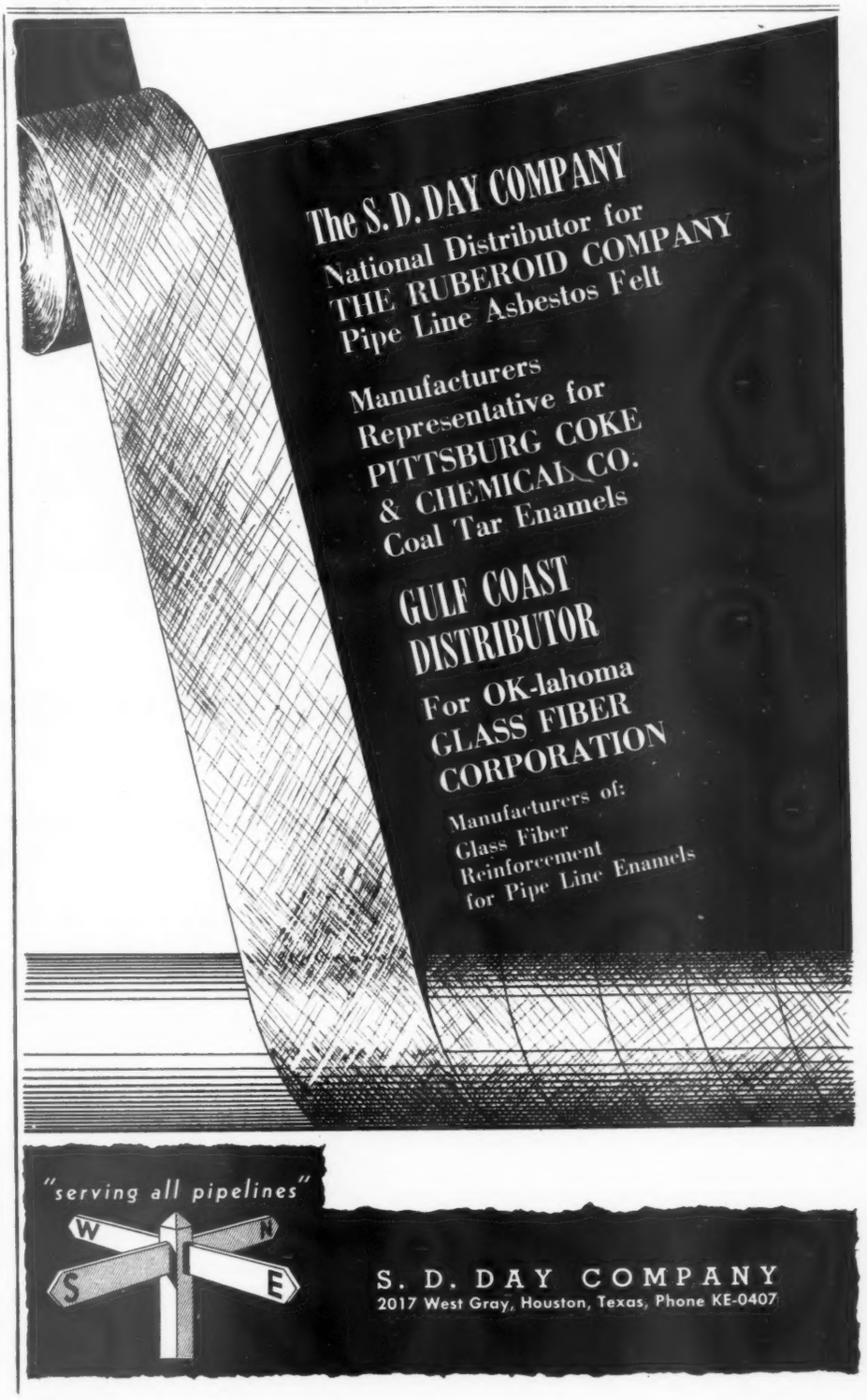
It is widely recognized that the installation of insulating gasket assemblies in flanges, at certain locations in pipe lines, will assist in the control of corrosion caused by stray electrical currents. However, heavy electrical surges—which result from the effects of lightning or other high-voltage sources—in some instances have punctured parts of the insulating assembly. Very recently an insulated washer has been developed for installation in place of the regular insulating washers on one of the flange bolts. This washer, in its thin insulating material, has perforations that act as a surge gap. This new assembly takes care of high voltage surges, and prevents damage to the more inaccessible parts of the gasket assembly. Other more intricately designed lightning arresters are being used to accomplish the same results.

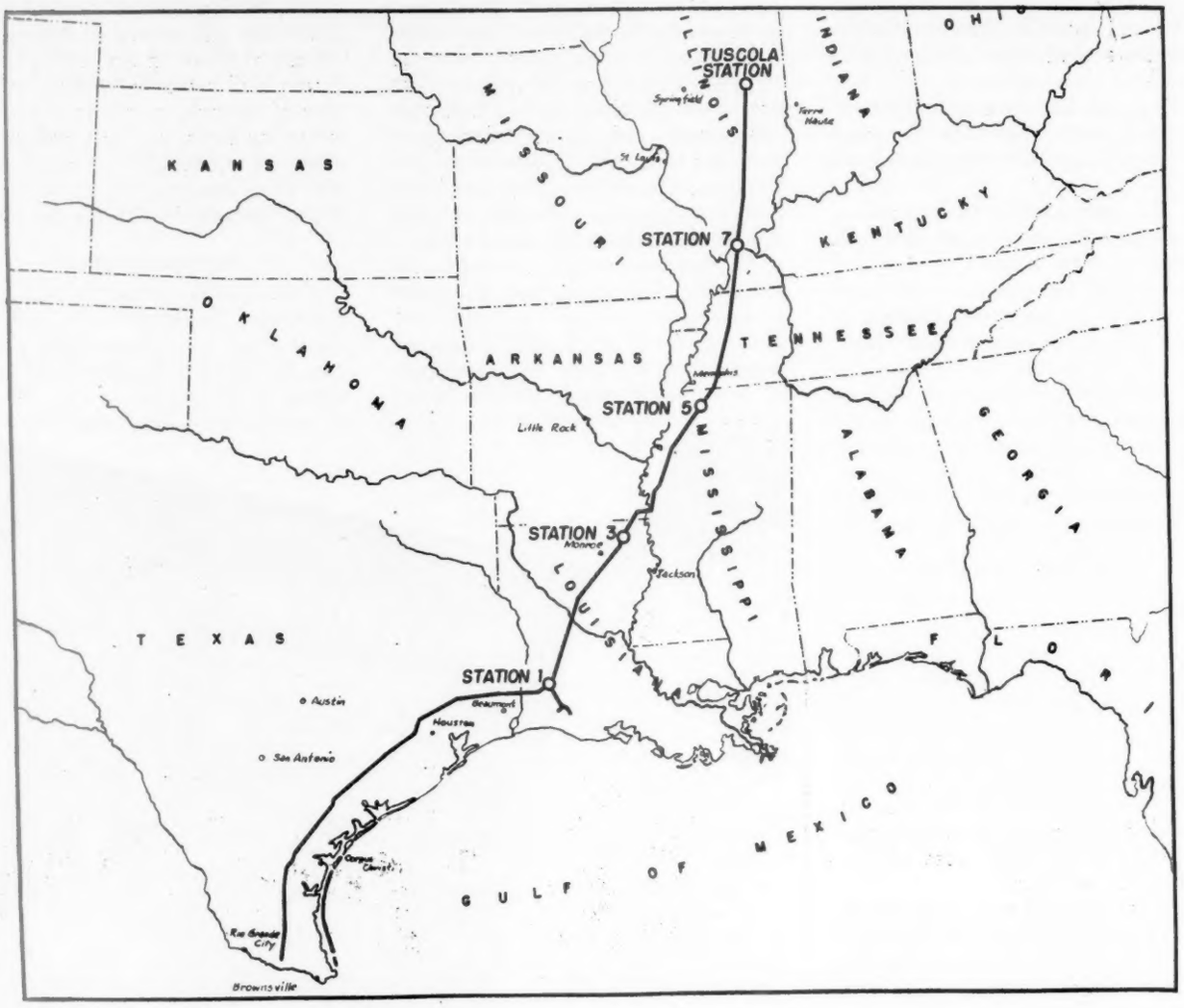
The advances made in corrosion mitigation during the last few years undoubtedly are paying large dividends in lower maintenance expense, longer pipe line life, and continuity of operation. Further research, continued development of new ideas and materials, and mutual exchange of the results of these efforts throughout industry will result in further conservation of valuable metals, in lower transportation costs, and in a reduction in losses of crude oil and products. In the final analysis, all these mean a higher standard of living for all.

Acknowledgment

Considerable credit is due Senior Corrosion Engineer O. C. Mudd, of Shell Pipe Line Corporation, Houston, for much of the information contained in this paper.

* * *





Second Longest Microwave System

Installation to serve 1300-mile Trunkline Gas Supply Company system will operate on 5 voice channels initially but when needed can be expanded readily up to 23 voice channels

TRUNKLINE Gas Supply Company. Houston, Texas, has contracted for a PTM (pulse-time-modulation) microwave communication system to serve its 1300-mile pipe line from natural gas fields in Texas and Louisiana to Tuscola, Illinois, where the main line route will tie-in with the Panhandle Eastern Pipe Line Company. It will be the second longest microwave system ever built for industrial communications.

Equipment for the new system will be manufactured and installed by Federal Telephone and Radio Corporation, Clifton, New Jersey, associate of International Telephone and Telegraph Corporation.

Initially, the new microwave system will be equipped for operation on five voice channels, with facilities for VHF mobile radio connection, dispatchers' operations, administrative, and telemetering. It is designed for ready expansion to a 23-voice-channel system to meet future service requirements. The PTM type of multiplexing, due to its flexibility and adaptability to short or long-hop operation, is especially suitable for cross-country distances found in the pipe line industry. PTM not only permits the use of simpler RF repeater equipment, but also provides telephone circuits of the highest quality and reliability, with unusually low maintenance cost.

A survey of the 1300-mile route is now under way to determine the best locations for unattended microwave repeater stations. Upon completion of the survey and the purchase of necessary land, work will begin on the construction of microwave towers and equipment housing and the installation of power lines. * * *

NEWS

Panhandle Eastern Amends Gas Export Application

Panhandle Eastern Pipe Line Company, of Kansas City, Missouri, has filed an amended application with the Federal Power Commission in connection with its plan to export natural gas to Union Gas Company of Canada, Limited, which operates in southwestern Ontario.

Under the new proposal, Panhandle would export approximately 18,250,000,000 cu ft of natural gas per year at a daily delivery rate ranging from 25,000,000 to 67,000,000 cu ft. Base price of the gas would be 27.5 cents per 1000 cu ft.

In its original application filed last March, Panhandle proposed to export approximately 27,350,000,000 cu ft per year, or an average of about 75,000,000 cu ft a day.

Panhandle would deliver the gas through an existing pipe line crossing under the Detroit River at the International Boundary near Detroit, Michigan. Construction of these facilities was authorized by the FPC in April, 1946, at which time Panhandle also received authority to export up to 5,500,000,000 cu ft of gas per year to Union provided the needs of Panhandle's U. S. customers were met first.

The Panhandle proposal to export gas is part of a consolidated proceeding now in progress before the commission. Hearings are to resume December 5 in Washington, D. C.

Mississippi River Fuel Emergency Rules in Effect

The Federal Power Commission allowed emergency service rules governing deliveries of natural gas to customers of Mississippi River Fuel Corporation, of St. Louis, Missouri, to take effect November 1 for the period ending February 2, 1952, subject to prior termination by order of the FPC.

Mississippi submitted the rules in compliance with a condition contained in an FPC order of August 23, which granted the company temporary authorization to construct four new compressor stations and to operate three others already built in order to increase the sales capacity of its natural gas transmission system.

The emergency service rules were worked out at a conference held at St. Louis on October 26. The conference was attended by 68 representatives of interested parties, including the Illinois Commerce Commission, the Missouri Public Service Commission, the Arkansas Public Service Commission, members of the FPC's staff, 6 utility customers, 28 direct customers, and Mississippi River Fuel. All parties in attendance expressed satisfaction with the proposed rules.

The rules provide for curtailment in two steps: (1) All of the interruptible sales by Mississippi under its interruptible rate schedules and contracts are curtailed to zero, and (2) firm sales to Mississippi's direct customers and to distributors are curtailed to certain specified volumes.

Mississippi, which owns and operates a transmission system extending from northern Louisiana through Arkansas and Missouri into Illinois, makes its principal sales in Illinois and Missouri in the vicinity of St. Louis, Missouri, and East St. Louis and Alton, Illinois.

First Export From Alberta To British Columbia

The first export of natural gas from the Province of Alberta over the provincial boundary into northeast British Columbia became a reality October 31, when the Honorable Harry Bowman, Minister of Agriculture of the Province of British Columbia, opened a valve in Dawson Creek, B. C., thereby delivering gas from the Pouce Coupe area of northern Alberta into the lines of Northland Utilities for distribution to residents of Dawson Creek. The line is believed to be the most northerly gas line in the world. The ceremonies were attended by representatives of the Alberta and British Columbia Governments and members of the oil and gas industry. George McMahon, a director of Westcoast Transmission Company, represented his firm at the affair. The line was built by Westcoast Transmission Company Limited of Calgary, one of the leading contenders for the right to build a major gas line from Alberta to the Canadian-American Pacific Coast area.

Completion of the Dawson Creek line gives Westcoast Transmission the distinction of being the first to actually lay line beyond the boundaries of Alberta and begin gas deliveries. The right to build the line and export gas was granted in a ruling of the Canadian Board of Transport Commissioners on July 20 last. Westcoast is purchasing the gas from Peace River Natural Gas Company, a subsidiary of Pacific Petroleums Ltd.

Westcoast Transmission Company is sponsored by Pacific Petroleums Ltd., of Calgary, Sunray Oil Company, and other members of the Pacific group engaged in active gas and oil exploration and development in western Canada, particularly in Alberta and northeast British Columbia.

Transfer Proposed of Natural Gas Facilities

Monongahela Power Company, of Fairmont, West Virginia, State Line Gas Company, of Point Marion, Pennsylvania, and Hope Natural Gas Company, of Clarksburg, West Virginia, have filed a joint application with the Federal Power Commission in connection with the proposed transfer of natural gas facilities in West Virginia.

Hope Natural is proposing to acquire Monongahela's entire natural gas production, transmission, supply, and distribution system in Marion, Monongahela, Harrison, and Wetzel counties, West Virginia. The base purchase price that Hope has agreed to pay for the properties is $2,369,351.

Monongahela, a subsidiary of The West Penn Electric Company, renders electric service in West Virginia and supplies natural gas to its wholly-owned subsidiary, State Line, at one point on its system, and receives gas from State Line at another point. After acquiring Monongahela's facilities, Hope proposes to supply the natural gas requirements of State Line over and above quantities available to it from other sources. This sale and delivery would be made until State Line's natural gas system in Pennsylvania has been sold to Peoples Natural Gas Company, an affiliate of Hope, pursuant to negotiations now in progress. After that, deliveries would be made to Peoples.

Monongahela and State Line are seeking authorization to terminate sales and deliveries of gas to each other, and Monongahela is also asking authority to transfer its facilities to Hope.

Hearing on Gas Line Sale is Postponed

The Federal Power Commission has postponed until January 26 the hearing previously scheduled to begin October 20 in Washington, D. C., on the joint application of Independent Natural Gas Company, of Pampa, Texas, and Northern Natural Gas Company, of Omaha, Nebraska, filed in connection with the proposed sale and acquisition of natural gas pipe line facilities in Texas.

The facilities, which Northern proposes to acquire from Independent, include 21 miles of pipe line and a compressor station. Northern would pay $229,200 for the facilities, which are now used by Independent to supply natural gas to Northern.

Northern requested the postponement for the purpose of permitting additional time for it to negotiate an agreement to purchase the facilities involved in the joint application.

FPC Proposes Amendment To Export-Import Rule

The Federal Power Commission has issued a notice of proposed rule making that would amend the FPC's regulations under the Natural Gas Act relating to requirements for filing of applications for authorization to export or import natural gas.

The proposed amendment is designed to eliminate the requirement now contained in the commission's rules that the owner of a source of supply of natural gas who proposes to export or import natural gas or who has entered or proposes to enter into a contract to supply natural gas to be exported or imported shall be a necessary party to an application for the authorization required under the Natural Gas Act.

J. D. Jones Heads Pipe Liners Club of Tulsa

The Pipe Liners Club of Tulsa has elected J. D. Jones of Gulf Pipe Line Company to head the organization for the 1950-51 term. F. C. Whiteside, Continental Pipe Line Company, was elected vice president; Sam L. Jackson, Service Pipe Line Company, secretary, and R. P. Lennart, Service, treasurer.

The newly elected members of the board of directors are W. E. Biery, Mid-Continent Pipe Line Company; J. R. Ellis, Sunray Oil Company, Pipe Line Division, and P. L. Reichard, Gulf Pipe Line Company. T. D. Williamson, Jr., of T. D. Williamson, Inc., will be serving the second year of a two-year term on the board.

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Transco Line Under Hudson River Real Engineering Feat

One of the most difficult engineering feats in the construction of the 1840-mile natural gas pipe line from Texas to New York was completed November 2 with the crossing of the Hudson River. The operation, measuring 4680 ft from the valving station at Edgewater, New Jersey, to the metering pier at 134th Street, Manhattan, is the longest river crossing in the entire system of Transcontinental Gas Pipe Line Corporation, comparing with the 4000-ft crossing of the Mississippi.

Manhattan got its first glimpse of the specially designed pipe when it emerged from the river next to the metering pier where the final welds were made. New York, Brooklyn, Long Island, and Westchester utilities will take delivery of their first natural gas at the metering station in early December.

Preparations for the Hudson River crossing have been under way since the spring of this year. Original plans of the contractor, which called for laying the pipe beneath the river bed by a high pressure jetting process, were changed when further exploration of the bottom revealed compacted silt that resisted the effect of the jets. Subsequently a deep trench was dredged across the river from the Jersey shore to a depth of 25 ft and a width of 30 to 50 ft.

The crossing technique finally adopted was a modification of the traditional method of welding a complete length of pipe and pulling it across to the opposite shore. Along the Hudson, proximity of the Palisades necessitated the fill-in of an apron of earth of sufficient area to accommodate 300-ft lengths of pipe. These pipe lengths were floated by barge from the welding yard a half-mile upstream and debarked on dollies mounted on two sets of rails laid side by side on the improvised apron. Reserve sections were rolled onto beams next to the rails.

When the pipe lengths were welded and moved down the rails into the river, the first section was supported by several barges steadied by a tug. As the flotilla moved out into the river the pipe passed through a sling mounted on pilings offshore, which served to keep the pipe in proper alignment over the trench previously dredged in the river bottom. In succession, the 300-ft pipe lengths were welded, X-rayed, and pulled into the river. Four winches exerting a 35-ton line pull were stationed under the West Side Highway; another winch and pulley arrangement on the New Jersey shore in effect exerted a push.

The New York end of the pipe, bent to conform with the profile of the main river channel, was inserted into a cofferdam alongside the new metering pier. There the last welds were made. Finally, the hook-up of the pipe in the river with the pipe on the Jersey shore was accomplished and all was in readiness for turning on the natural gas December 1.

Two Shell Divisions Merged and Renamed

Realignment and renaming of two Mid-Continent divisions are announced by the Shell Pipe Line Corporation. The Tonkawa division, the Elk City-Cushing line, and the Cushing district have been merged into one division known as the Cushing division. J. R. "Roy" Floyd has been made division superintendent at Cushing. I. C. Murphy remains at Cushing as district superintendent.

The other change was in the Missouri division, which was renamed the Ozark division. This change reflects the dominant position of the Ozark System in operations of that division.

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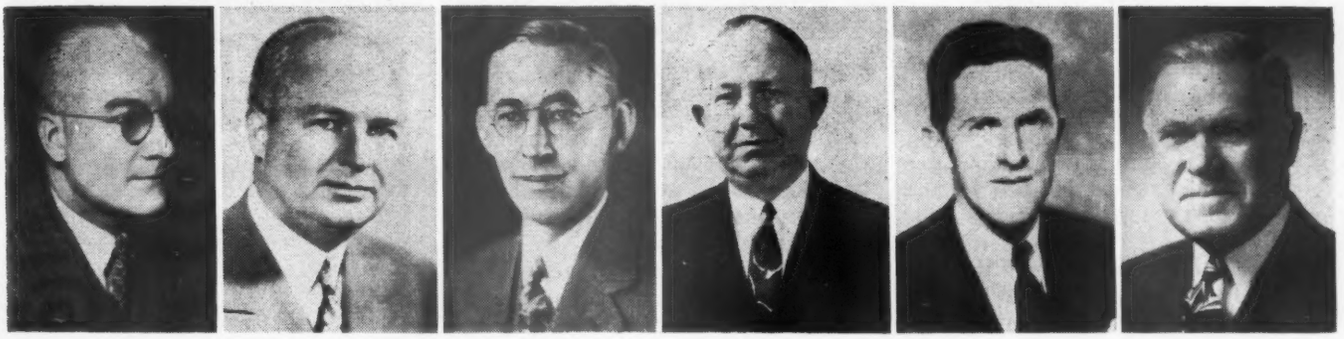
API Division of Transportation Men Awarded Certificates of Appreciation



H. H. Anderson | W. Alton Jones | Paul H. Kuhns | H. A. McKim | J. W. Sinclair | J. H. McEachern

The Division of Transportation of the American Petroleum Institute awarded seven "Certificates of Appreciation" during the Institute's 30th Annual Meeting in Los Angeles. One award, given to C. M. Rosebrugh, was made posthumously.

Those receiving Certificates of Appreciation were:

Hallam H. Anderson, Shell Pipe Line Corporation, Houston, Texas, member of the Central Committee on Pipe Line Transportation, and member and chairman of the Committee on Pipe Line Technology.

W. Alton Jones, Cities Service Company, New York, chairman of the General Committee, and vice president of the API Transportation Division.

Paul Hughes Kuhns, Continental Oil Company, Ponca City, Oklahoma, as a member of the General Committee and the Central Committee on Railroad Transportation, and chairman of the Joint Committee on Tank Truck Shipping Practices.

Joseph Hambric McEachern, retired, formerly with Standard Oil Company of California, San Francisco, member and vice chairman of the Central Committee on Transportation by Water.

Horton Albert McKim, Standard Oil Company of California, San Francisco, member of the General Committee, chairman of the Committee on Automotive Engineering, and member and vice chairman of the Central Committee on Automotive Transportation for service rendered.

James William Sinclair, Union Oil Company of California, Los Angeles, member of the General Committee and member, vice chairman, and chairman of the Central Committee on Automotive Transportation.

A posthumous award was made to: Crawford Monroe Rosebrugh, formerly with Gulf Refining Company, Houston, Texas, former vice chairman and chairman of the Engineers -Accountants Pipe Line Valuation Subcommittee, and chairman of the Subcommittee on Pipe Line Hydraulics.

Work Begins on Shell's Elk City Pump Station

Contract for constructing Shell Pipe Line Corporation's Elk City, Oklahoma, pump station was let to the Refinery Maintenance Company, Inc., of Compton, California, T. E. Swigart, president of the pipe line company, announced. Work was scheduled to get underway by November 15, with completion by February, 1951.

The new station will pump crude oil and distillate from the Elk City field to Cushing, Oklahoma. Modern in design, the masonry building will be 27 ft wide by 47 ft long. A 500-hp electric-motor-driven centrifugal pump will be installed, with an additional unit to be set later. Original pumping capacity will be approximately 25,000 bbl daily.

The Elk City pump station is 5 miles south of Elk City and adjacent to Shell Oil's new gasoline plant. Crude oil is being pumped at present by two field pumps over the 160-mile, 10-in. Elk City-Cushing line. At Cushing the crude enters the Ozark Pipe Line System for delivery into Shell Oil's Wood River, Illinois, refinery.

Interstate General Offices To Be Moved to Shreveport

General offices of the Interstate Oil Pipe Line Company will be moved from Tulsa, Oklahoma, to Shreveport, Louisiana, the change to be consummated by July 1, 1951.

Interstate will retain a two division operating organization with Tulsa as the operating headquarters of the Northern division and Shreveport headquarters of the Southern division. Shreveport, however, will become the home office of the company, a move that will involve the transfer of corporate staff personnel and activities from Tulsa to Shreveport. Administrative and service functions common to both divisions, such as engineering, accounting, employee relations, medical, etc., will be gradually consolidated into the general office organization.

Ten Employees On Loan to Tapline

Eight employees of the Interstate Pipe Line Company and two of the Ajax Pipe Line Company have been temporarily loaned to the Trans-Arabian Pipe Line Company in Saudi Arabia. The loan period is for six to nine months, during which time they will help get the Tapline into operation and train native personnel to take over the jobs.

The employees are: Garrett B. Fisher, C. W. McSpadden, Earnest C. James, and W. E. Kent of Interstate's Wewoka district; B. W. Manning, Jerry L. Thorpe, F. D. McCleskey, and P. E. Bradley, Wilson district; and J. E. Cook, and Joe Ben Holland of Ajax.

Bayou Wins National Fleet Safety Contest

Top divisional honors in the National Safety Council's annual National Fleet Safety Contest have been won by the Bayou Pipe Line System, operated by Shell Pipe Line Corporation at Houston, Texas. T. E. Swigart, president of Shell Pipe Line, said that the first place was won in the Petroleum Inter-City Truck division for driving 150,741 miles from July, 1949, through June of this year with an accident-free record. Under contest rules, the slightest scratch or fender dent is considered a reportable accident.

Almost 1500 fleets, representing bus, truck, taxicab and passenger car fleets, completed the contest. All drove a total of more than 2,000,000 miles with only 1.86 accidents per 100,000 vehicle miles. This rate represented a 40 per cent improvement over the rate for last year's contest.

In presenting the awards, Franklin M. Kreml, director of Northwestern University's Traffic Institute, termed the record "one of the brightest spots in the national traffic accident picture today." The record, he said, proved that accidents can be cut down.

PIPELINE PERSONALS

Ralph C. Graham has been elected a vice president of the Tennessee Gas Transmission Company. Graham entered the oil business in 1934 as an employee of the Carter Oil Company, Tulsa, Oklahoma, advancing to the position of division engineer. He left Carter in July, 1939, to go with Security Engineering Company at Whittier, California. Later he was transferred to the Houston, Texas, office as chief engineer. After a year in the Houston office, Security, which manufactured its products from aluminum, was forced to convert from civilian production to the manufacture of war materials, and it was at this time that Graham joined the British American Oil Company as division engineer at its Wichita Falls, Texas, branch. After being on loan to British American in Canada he was transferred back to Houston as production superintendent. He resigned this post in November, 1945, to become chief geologist of TGT. When the Coast Company, subsidiary of TGT, was merged with Sterling Oil and Gas Company, now a TGT subsidiary, he was elected vice president of Sterling, a position that he continues to hold.

Delbert Y. Hewitt has been promoted to president of the Leonard Pipe Line Company and **John J. Devine** advanced to vice president. The advancements were made by directors following the annual stockholders and directors meetings.

J. Walter Leonard, organizer of the pipe line company and other affiliated producing and refining companies, continues as chairman of the board of Leonard Pipe Line. He also had served as president last year.

Hewitt, associated with the purchasing and transporting branch of the oil industry for 20 years, joined Leonard in 1948, as executive vice president.

Devine, with the company since 1938, and general manager since 1948, will continue as general manager along with the vice president of the company.

Other officers include **Grant L. Cook,** of Detroit, secretary-treasurer; **F. M. McClean,** assistant secretary and **Robert Lyle,** assistant treasurer.

Directors include Hewitt, Devine, Leonard, Cook, and Bernard M. Jones.

E. L. Hosler, district gager at Graham, Oklahoma, for Interstate Oil Pipe Line Company, has retired after 38 years and 10 months' service.

D. H. Tucker has been elected vice president of the El Paso Natural Gas Company and will continue to maintain his offices in Houston, Texas, where he has been superintendent of the contract department.

V. M. Plummer, formerly office manager of the contract department, has been elected assistant secretary. He also has his headquarters in Houston.

Fred T. Johnson has been given the title of chief welding engineer. Formerly welding foreman, he has been acting in his present capacity for several months.

C. E. Booth has been named assistant plant superintendent in charge of the new Hobbs plant. He has been plant operator in the Keystone field.

Sanford Chambers was recently made assistant traffic manager.

H. L. Cook is now district foreman in the transmission department, assigned to the El Paso district.

Nathan W. Ray has been promoted to foreman of the Tucson district.

N. V. Ruebush has been made district foreman in the transmission department and assigned to the El Paso district.

Howard S. Riddle, who has been head of the welding and pipe design department for Columbia Engineering Corporation at Columbus, Ohio, has been made manager of the staff engineering department of the Charleston Group companies and is now making his headquarters in Charleston, West Virginia.

Leo Dippel has been appointed supervisor of a personnel section of the operating department of Northern Natural Gas Company in addition to his duties as supervisor of safety. In his new position he is reponsible for operating and expanding the personnel section that includes field and office departments of pipe line, dispatching, compressor, engineering, and measurement.

A. C. Poulk, superintendent of Division A, has been promoted to assistant pipe line superintendent of the Tennessee Gas Transmission Company. **Frank H. Smith,** safety engineer, has been made superintendent of Division A. **Ray L. Davis,** formerly at Kenova, West Virginia, has been elevated to assistant gas measurement superintendent and transferred to Houston, Texas.

J. B. Harshman

J. B. Harshman has been named vice president in charge of the H. C. Price Company's pipe line division, Bartlesville, Oklahoma. Harshman will succeed **J. P. Neill,** who is leaving the Price organization the first of the year to engage in independent operations.

The new vice president joins the Price company from Fish Constructors, Inc., of Houston, Texas. During the past year and a half Harshman has been stationed in the east, supervising construction operations on the New Jersey-New York end of the Transcontinental Gas Pipe Line Corporation project. A native of Fremont, Iowa, he was educated in the public schools of Iowa and Illinois, where he resided for a number of years. In 1920 he moved to Oklahoma and entered the employ of the Sinclair Pipe Line Company, which later became the Stanolind Pipe Line Company. Beginning as an engineer in a pumping station, Harshman spent the ensuing 28 years in various capacities with Sinclair and Stanolind.

He is a registered professional engineer in New Jersey, a member of the American Society of Mechanical Engineers, and the American Petroleum Institute.

Roy S. Lunday, former pipe line foreman in District 1, Stinnett, Texas, for Panhandle Eastern Pipe Line Company, has been made district foreman replacing **J. E. Steward,** who is acting division pipe line superintendent at Liberal, Kansas.

Delbert N. "Dick" Smith has taken over the duties of foreman of District 2, Liberal, replacing **W. C. Spellman** who is now with Trunkline Gas Supply Company. He formerly was truck driver, heavy, at Boonville, Missouri.

▸ **J. W. Alix** has been made superintendent of Northern Natural Gas Company's new compressor station at Holcomb, Kansas. He was formerly assistant superintendent of the Sublette, Kansas, station. **Merlin J. Esslinger** has been promoted to assistant superintendent at Sublette. He has been master mechanic at Clifton, Kansas.

▸ **Robert T. Haslam,** who recently retired as vice president and director of Standard Oil Company (New Jersey) after 23 years' service, has joined E. Holley Poe and Paul Ryan, as one of the principals of United States Pipe Line Company. Effective immediately, Haslam has been elected president and director of United States Pipe Line Company, the new independent products pipe line system.

▸ **A. W. Breeland** has been appointed assistant director of personnel by Lone Star Gas Company, Dallas, Texas. He will continue to supervise and coordinate the safety-training programs of the company in addition to his new duties.

▸ **R. T. Powers,** superintendent of operations of Natural Gas Pipeline Company of America and Texoma Natural Gas Company, died unexpectedly October 7 of a cerebral hemorrhage at his home in Evanston, Illinois. Powers had been with the Company since 1930. He was highly instrumental in solving technical problems and making possible the first long-distance pipe line for natural gas transmission. The pipe line brings gas to the Chicago area from the Texas Panhandle.

Dwight B. Sprow, formerly assistant to Powers, will succeed him as sity of Missouri in 1919.

▸ **Harrison F. Carr,** New Orleans district manager for United Gas Pipe Company and Union Producing Company, retired recently. Carr will be succeeded by **J. B. Storey** of Shreveport, Louisiana, who has been assistant district manager at New Orleans for nearly 3 years. On August 26, 1950, Carr completed 23 years of service with the United Gas companies. He also recently celebrated his 65th birthday. As district manager in Baton Rouge and New Orleans, he was a well-known figure in the swift development of the oil and gas industry in south Louisiana. He is a member of the Louisiana Engineering Society and is credited with assisting in development of the practice of floating lengths of pipe line through canals and ditches, which is now widely used in swampy areas.

Storey who succeeds Carr as New Orleans district manager, has worked in the United Gas organization for nearly 16 years, having joined the firm during the development of the Rodessa field in Caddo Parish. He was district geologist at Jackson, Mississippi, from 1941 to the end of 1947, when he became assistant district manager at New Orleans in January 1948.

▸ **Ernest Thalman** of Ebasco Services Incorporated, New York City, addressed the North Texas Section of the National Association of Corrosion Engineers at the November 13 meeting in Fort Worth, Texas. His subject was: "Corrosion Control Instruments: Their Use and Interpertation."

▸ **Robert Stewart Bruns, Jr.,** has been elected a vice president of Transcontinental Gas Pipe Line Corporation. He will be in charge of all phases of the corporation's Eastern operations. A graduate mechanical engineer, Bruns has had wide experience in the heating field. Prior to joining Transcontinental last year, he had served in an executive capacity with Preferred Utilities Manufacturing Company, on the design and development of oil and gas-fired generating equipment.

At Transcontinental, he has been in charge of contract and customer relations in the New York area.

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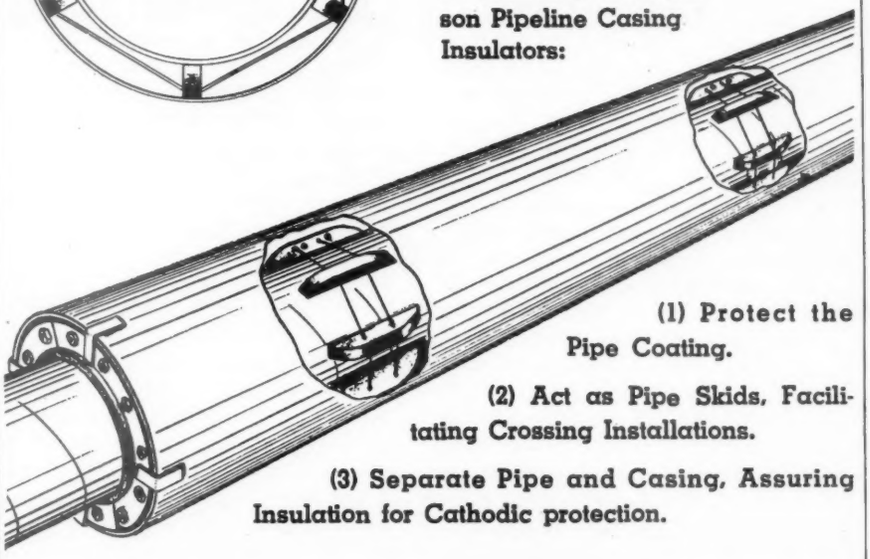

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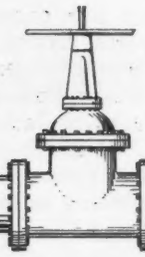
PIPE LINE PROJECTS



Westcoast Transmission Files FPC Application

Westcoast Transmission Company, Inc., the American affiliate of Westcoast Transmission Company, Limited, has filed an application with the U. S. Federal Power Commission in Washington, D. C., for a Certificate of Public Convenience and Necessity, for authorization to construct and operate a pipe line for the transportation of natural gas in the states of Washington and Oregon, according to an announcement by Frank M. McMahon, president of the company.

Natural gas for the contemplated line, which proposes to serve the cities of Seattle, Tacoma, Portland, Spokane, and the atomic energy plant at Hanford, will be obtained by the company from Westcoast Transmission Company, Limited, its Canadian associate. Westcoast Transmission Company, Limited, is one of the leading contenders for the right to build a major gas pipe line from Alberta to the Canadian-American Pacific Coast.

The proposed Westcoast line, which will utilize the extensive gas reserves in the northern areas of the provinces of Alberta and British Columbia, would originate in northern Alberta and run through the Province of British Columbia, south to a point on the international boundary near Sumas, Washington, where the line would be joined with that of the American company. The pipe line system also would meet the international boundary west of Osoyoos, British Columbia, and connect with the American company's line to serve Spokane and the atomic energy plant at Hanford in the state of Washington.

The route of the Westcoast line through Canada has been planned to serve the various small towns throughout British Columbia and terminate in Vancouver, British Columbia.

Both the Canadian and American companies are planning to begin immediate construction of the proposed lines as soon as the necessary permission is granted by Canadian and American regulatory bodies.

Westcoast Transmission Company, Limited, filed an application on January 31, 1950, with the Petroleum and Natural Gas Conservation Board of the Province of Alberta for authority to export natural gas. The board has held extensive hearings on the application of Westcoast and other applications. The company anticipates an early conclusion of these hearings.

The company believes that the testimony presented to date clearly indicates that the gas reserves that have been and are being developed are more than adequate to supply the future needs of the Province of Alberta and supply the export needs of Westcoast.

Westcoast is sponsored by Pacific Petroleums, Ltd., of Calgary, Sunray Oil Corporation, and other members of the "Pacific Group" engaged in active oil and gas exploration and development in western Canada.

Omit Intermediate Step In Transco Application

The Federal Power Commission has ordered the intermediate decision procedure omitted in the proceeding involving the proposal of Transcontinental Gas Pipe Line Corporation, of Houston, Texas, to change the authorized compressor horsepower at stations and to construct a pipe line extension in New Jersey.

The case will now go directly to the commission for decision without the filing of an intermediate decision by the presiding examiner. Delivery and sale of the natural gas to be transported through the proposed facilities previously was authorized by the commission. Engineering difficulties encountered during the course of the construction necessitated the change in facilities sought in this proceeding, the FPC said, and construction crews are standing by awaiting authorization to proceed.

Transcontinental is proposing to increase its authorized horsepower from the present 61,760 to a new total of 67,110. In addition, the company plans to build 8.5 miles of 30-in. line and 8.5 miles of 10¾-in. line extending from a point on its main natural gas transmission line in Bergen County, New Jersey, to the Paterson Gas Works of the Public Service Electric and Gas Company in the Paterson, New Jersey, area.

El Paso Gas Granted Temporary Authorization

The Federal Power Commission has granted a temporary certificate to El Paso Natural Gas Company, of El Paso, Texas, for the construction of pipe line facilities designed to increase natural gas deliveries to the Phoenix, Arizona, area.

The construction program, estimated to cost $1,038,404, will increase the capacity of El Paso's facilities to serve the Phoenix area by 67,000,000 cu ft a day, making a total capacity of approximately 143,000,000 cu ft daily.

El Paso plans to build approximately 31 miles of combination 16-in. and 10-in. line; about 11.5 miles of 4½-in. line; approximately 5.5 miles of 12¾-in. line; and six new city gate metering and regulating stations.

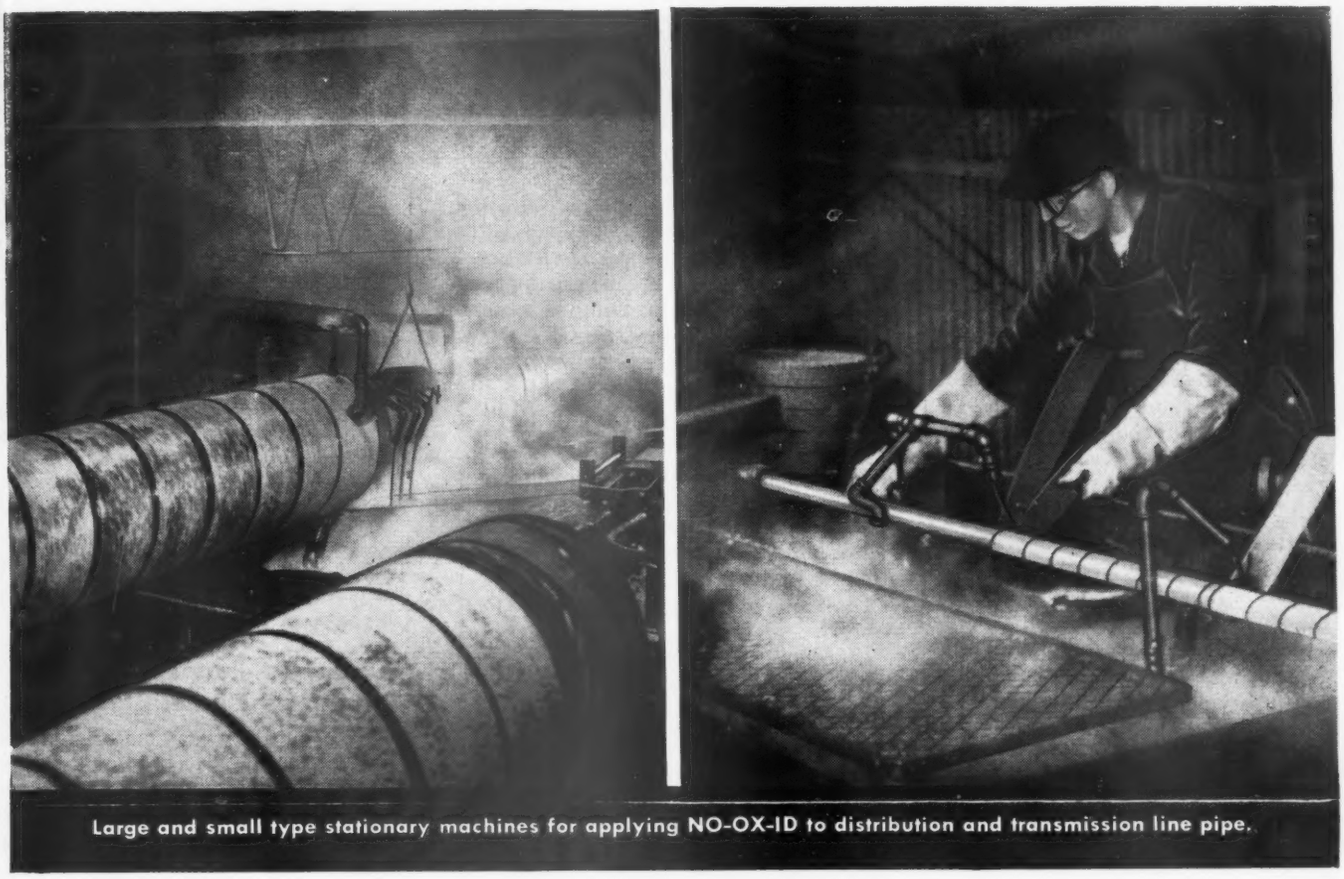
The commission conditioned the temporary authorization by directing that the proposed increased deliveries of gas in the Phoenix area shall not be made when such gas is required by other resale customers.

Gas Line Proposed For Missouri Communities

Missouri Central Natural Gas Company, of Macon, Missouri, has asked the Federal Power Commission for authority to build approximately 60 miles of pipe line designed to carry natural gas for distribution in Macon, Clarence, Shelbina, and Monroe City, Missouri. Estimated overall capital cost of the proposed project is $1,200,000.

Missouri Central also is seeking an FPC order directing Panhandle Eastern Pipe Line Company, of Kansas City, Missouri, to connect its transmission system with the facilities to be constructed by Missouri Central and to sell natural gas for the proposed project.

The proposed 60 miles of line, to be of 6-in. diam pipe, would extend from a connection with Panhandle's system near Hannibal, Missouri, in a westerly direction to Macon. The project also would include measuring and regulating stations and extensions to connect the line with distribution systems in the four cities proposed to be served.



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Acquisition of Storage Facilities Approved

The Federal Power Commission has authorized Texas Eastern Transmission Corporation, of Shreveport, Louisiana, and New York State Natural Gas Corporation, of New York City, jointly to acquire, develop, and operate a multi-million dollar underground storage project in Westmoreland County, Pennsylvania.

Under the authorization, the two companies will acquire the Oakford Storage Area from Peoples Natural Gas Company, an affiliate of New York State Natural in the Consolidated Natural Gas Company system. Estimated overall capital cost of the project is $20,250,129 for New York State Natural; $20,522,791 for Texas Eastern.

The companies plan to inject a total of 105 billion cu ft of natural gas into the storage pools, 60 billion cu ft of which will be available for withdrawal, with the remaining 45 billion cu ft serving as "cushion" or "base storage" gas. The two companies each will have an undivided one-half interest in the project.

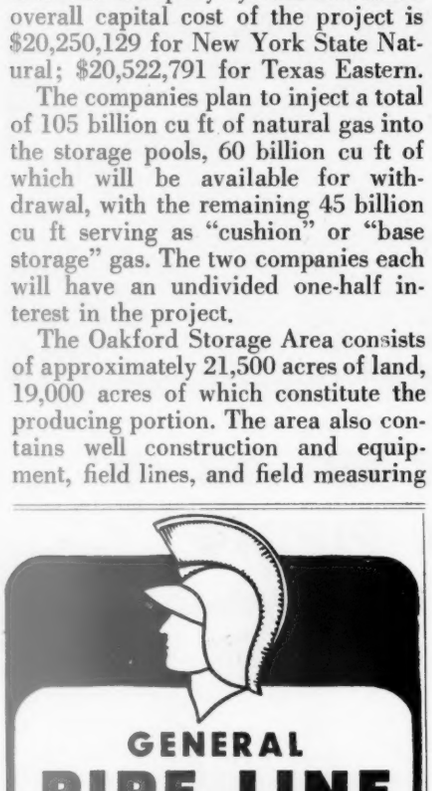
The Oakford Storage Area consists of approximately 21,500 acres of land, 19,000 acres of which constitute the producing portion. The area also contains well construction and equipment, field lines, and field measuring and regulating station equipment. Development of these facilities for storage purposes will be carried out by drilling new wells, reworking active wells, reconditioning and replugging abandoned wells, and constructing approximately 13 miles of 20-in. trunk gathering lines, 87,000 ft of 8-in. well lines, 86,000 ft of 6-in. well lines, three pool meters, two measuring stations, 173 individual well measuring stations, one 30,000-hp compressor station, one dehydration plant, and appurtenant facilities.

New York State Natural will build a 70-mile, 20-in. pipe line extending from the storage area to a connection with facilities of the East Ohio Gas Company, another affiliate, at the Ohio-Pennsylvania state line. This line would be used in making deliveries of gas withdrawn from storage to East Ohio and to Peoples.

The commission said that the record shows a steadily increasing peak period demand for natural gas service in the Pittsburgh-Cleveland area, which may be satisfied by providing the additional storage facilities.

Texas Eastern, which will construct a 35-mile, 30-in. line, extending from the storage area to a connection with its system in Pennsylvania, plans to sell its storage gas on a spot basis to markets in the eastern part of its system, including the Philadelphia, New Jersey, and New York area. The gas would supply those of Texas Eastern's distributing utility customers that do not have storage, thus providing them with a source of supply of gas with which to meet expected house-heating loads at a lower price than would be if peak shaving facilities were employed.

According to the plan of development, all base storage gas in the Oakford project will be delivered by Texas Eastern, and it is expected that the total volume of 45 billion cu ft will have been placed in storage by 1955. Title to half of this base storage gas will be transferred to New York State Natural. Each company will provide its own top storage gas, with New York State Natural providing its portion through purchases from Texas Eastern under a service agreement.



Texas Company Contracts 56-Mile Oil Pipe Line

The Texas Pipe Line Company has awarded a contract to R. H. Fulton and Company, Lubbock, Texas, to construct a 56-mile pipe line from a point near the Wichita Falls pump station to Chico pump station, Wise County, Texas, announced R. B. McLaughlin, president of the pipe line company.

The 12¾-in. crude oil line will extend line from Corsicana to Chico.

To Build Facilities To Gas Storage Pool

The Federal Power Commission has authorized United Fuel Gas Company, of Charleston, West Virginia, to construct and operate approximately 5.5 miles of pipe line and three compressor stations with a total horsepower of 6460 in connection with the expansion of underground storage facilities in West Virginia.

The facilities, estimated to cost $2,621,061, are part of a long-range program by United Fuel for the development of underground storage facilities to enable it to store volumes of gas received from the Southwest in off-peak periods for subsequent withdrawal in peak periods, in order to meet its own and a portion of the balance of the growing winter gas requirements of its parent, the Columbia Gas System, Inc.

Request to Reopen Hearing is Denied

The Federal Power Commission has denied a motion by Carolina Natural Gas Corporation, of Charlotte, North Carolina, to permit the company to file a third amended application and to reopen the hearing in the proceeding involving proposed natural gas service in North and South Carolina.

Carolina Natural, Piedmont Natural Gas Company, Inc., of Spartanburg, South Carolina, and Public Service Company of North Carolina, of Gastonia, North Carolina, all want to serve the Carolinas with natural gas to be supplied by Transcontinental Gas Pipe Line Corporation, of Houston, Texas. Hearings in the consolidated proceeding have been concluded.

The FPC Trial Examiner denied a similar motion by Carolina Natural during the course of the hearing, and the company subsequently filed a written motion with the commission supplementing its oral motion. The oral motion was opposed by Public Service, Piedmont, Transcontinental, FPC staff counsel, and other intervenors, and both Piedmont and Public Service filed answers in opposition to the written notice.

Carolina Natural proposed in its amended application to serve additional markets not included in its earlier plans.

The commission said that Carolina Natural's oral motion was properly disposed of by the Presiding Examiner, and stated further that "it is in the public interest for the commission to determine expeditiously the merits of this consolidated proceeding, and Carolina Natural's motion should be denied. . . ."

FPC Rules on New England Gas Supply

The Federal Power Commission has issued an opinion and order authorizing Northeastern Gas Transmission Company, of Boston, Massachusetts, to supply part of the New England area with natural gas. The FPC stated it was of the opinion that the balance of the markets should be served by Algonquin Gas Transmission Company, also of Boston, upon a showing that it has an adequate supply of gas.

The commission at the same time authorized Tennessee Gas Transmission Company, of Houston, Texas, to carry out a $118,643,545 expansion program. Tennessee is the parent of Northeastern, and the newly approved facilities will be used in part to supply a portion of the natural gas requirements of the subsidiary.

Other authorizations contained in the opinion and order are for (1) Transcontinental Gas Pipe Line Corporation, of Houston, Texas, to extend its system to the New York-Connecticut state line in order to supply part of Northeastern's natural gas needs; and (2) for New York State Natural Gas Corporation, of New York City, and Niagara Mohawk Power Corporation, of Syracuse, New York, to build facilities in New York State.

Northeastern was authorized to serve markets in Massachusetts, Connecticut, and New Hampshire. The proposed project includes more than 400 miles of pipe line and other metering and regulating facilities required to serve authorized customers. The main lines will connect with Tennessee's system near Pittsfield, Massachusetts, and with Transcontinental's system near Greenwich, Connecticut.

Total estimated peak day requirements in the fifth year (1956) of the companies that Northeastern is authorized to serve are 207,000,000 cu ft, and the total estimated annual requirements for the same year are 47,000,000,000 cu ft. Tennessee will supply Northeastern with 156,000,000 cu ft per day and Transcontinental will deliver about 64,000,000 cu ft.

The Tennessee Gas Transmission Company project authorized by the commission will increase capacity of that company's system by 250,000,000 cu ft of natural gas per day to a total of 1,310,000,000 cu ft daily. The project includes a 303-mile main line extension from the eastern terminus of Tennessee's authorized Kentucky-to-Buffalo pipe line in Erie County, New York, to the point of connection with Northeastern's facilities on the New York-Massachusetts state line. In addition, Tennessee was authorized to (1) build approximately 786.6 miles of loop along its existing or authorized line between Texas and Buffalo; (2) to install compressor units aggregating 69,600 hp in existing or authorized compressor stations and 42,080 hp in seven new compressor stations, and (3) to construct about 75 miles of lateral gas supply lines.

The Transcontinental Gas Pipe Line Corporation facilities involved in the authorization include approximately 35.5 miles of 24-in. line from a point in Bergen County, New Jersey, to a point near Greenwich, Connecticut, together with a 6000-hp compressor station in Westchester County, New York, and an 8-in. lateral to serve Paterson, New Jersey. Estimated cost of these facilities is $6,504,000. However, since Transcontinental has proposed certain substitutions in another application now pending, the FPC authorization of these facilities is subject to final action in that proceeding.

New York State Natural's authorized project includes about 164 miles of 16-in. line in New York State extending from Dryden to the Albany area; a 56-mile line from the Dryden terminus to a storage pool in Tioga County, Pennsylvania, and other facilities necessary to develop a new storage pool. Estimated cost of these facilities is approximately $13,118,000.

New York State Natural will deliver up to 15,000,000,000 cu ft of natural gas annually on a firm basis to Niagara Mohawk, which was authorized to build approximately 7.4 miles of 16-in. line and 3 miles of 12-in. line from two connections with New York State Natural's authorized Albany line. The two lines will connect with Niagara Mohawk's Utica-New York system. Niagara Mohawk also will build four sections of line, aggregating 15.3 miles, connecting New York State Natural's system with Niagara Mohawk's Canajoharie gas plant, Amsterdam Transmission System, Schenectady gas plant, and its transmission system in Albany County. Estimated cost to Niagara Mohawk is $1,342,000.

New River Gas Company Asks Authorization

New River Gas Company, a new corporation, of Radford, Virginia, has asked the Federal Power Commission for authority to build a 50-mile natural gas transmission line to serve five cities in southwestern Virginia. New River also requested the FPC to order Altantic Seaboard Corporation, a member of the Columbia Gas System, with offices in Charleston, West Virginia to connect its facilities with those proposed to be built by New River, and to sell the latter company its requirements of natural gas.

Work Begins on New Iraq Petroleum Company Line

The first shipment of pipe for the 30-in. pipe line, which will treble current deliveries of Kirkuk crude oil to the Mediterranean, has arrived at Tripoli.

The pipe line, which will have a capacity of 13,000,000 tons a year, will connect the Kirkuk oil field in Northern Iraq with the Mediterranean seaboard at Banias. It will be 560 miles long and will require 145,000 tons of 30 and 32-in. pipe, and 23,000 tons of 26-in. pipe. Arrangements have been made with Furness Withy and Company for the charter of 42 vessels for shipping the pipe from the United States to the Mediterranean port of Tripoli (Lebanon) and to Basrah in the Persian Gulf. To convey it to site from these ports will involve 25,000,000 ton-miles of rail transport, and another 25,000,000 ton-miles of motor transport across the Iraq and Syrian desert. Laying of the pipe has now begun and is due for completion in 1952. The pipe has been ordered from the Consolidated Western Steel Corporation of Los Angeles, and the National Tube Company of Lorain, Ohio, as there is inadequate European capacity for 30-in. pipe, but the pump station and other auxiliary equipment was ordered in the United Kingdom.

The cargo of pipe that arrived at Tripoli on S.S. "Ixia" on November 5, sailed from Baltimore on October 14 and consists of 3224 tons, or 13.4 miles of 26-in. pipe. It will be used for the downhill gradients from the saddle of the Home Gap to the sea coast at Banias. The remainder of the line will consist of 30 or 32-in. pipe, in approximately equal proportions. and it has been so ordered to permit nesting of the 30-in. inside the 32-in. for shipment. The first cargo of 30/32-in. pipe sailed on the "Middlesex Trader" from Los Angeles on September 30 and arrived at Basrah on November 15.

Preparations for expanding the production of the Kirkuk field from the 1950 level of 6,000,000 tons are well in hand, and when the new line is complete in 1953, more than 18,000,000 tons a year of Iraq crude oil will flow to the Mediterranean.

S. S. Smith Addresses Tulsa Pipe Liners

S. S. Smith, vice president of Shell Oil Company, Inc., and manager of the Products Pipe Line Division, gave an informal talk at the November 20 meeting of The Pipe Liners Club of Tulsa on the subject of automatic pipe line pump stations. This subject is of widespread interest to industry.

With the PIPE LINE CONTRACTORS

Ray L. Smith and Son, Inc., El Dorado, Kansas, are operating two gangs on work for Commonwealth Natural Gas Company in Virginia. One spread has approximately 100 miles of 18-in. from Stanardsville southeast. One section consisting of 45 miles has been completed except for clean-up and the other section of 55 miles is about 95 per cent completed.

The other gang is laying 84 miles of 12-in. from Petersburg to Newport News and Norfolk. Work was recently started from Suffolk. The gang working on the 18-in. will help with the 12-in. as soon as its job is completed. Wm. G. Frost is superintendent for the 18-in. and is making his headquarters at Richmond. R. M. Jones has charge of the 12-in. and makes his headquarters at Suffolk.

An undetermined amount of work in the City of Norfolk has been contracted with the Virginia Electric Power Company but personnel has not yet been selected.

Parkhill Truck Company, P. O. Box 1856, Tulsa, Oklahoma, (stringing contractors) has the following jobs under way:

217 miles of 24-in. for Anderson Bros. Construction Company on Trunkline Gas Supply Company job from Longville, Louisiana, to Garwood, Texas. Started October 22. John McNutt, foreman.

33 miles of 20-in. 18 miles of 16-in., and 8 miles of 10-in. on Trunkline for Houston Contracting Company from Longville, Louisiana, to Southwest Louisiana. A. L. Hill, foreman for 20 in. and Paul Lyles for 16-in. Started October 28.

176 miles of 26-in. for Houston Contracting Company on Trunkline job between Longville and Darnell, Louisiana. Foreman, F. L. Bridges.

100 miles of 26-in. for Midwestern Constructors, Inc., on Texas-Illinois Natural Gas Pipeline Company project from La Gloria to Refugio, Texas. Harold Deatherage, foreman. Started October 18.

417 miles of 30-in. pipe for Section 7, 8, 9, and 10 for the Texas-Illinois Pipeline for Bechtel Corporation from Texarkana, Arkansas, to the Mississippi River near Cape Girardeau, Missouri. Foreman, Charles Sampson on Section 9; Jimmie Stubblefield on Section 7.

300 miles of 30-in. for Sections 11, 12, and 13 on the Texas-Illinois job for Midwestern Constructors, Inc., from the Mississippi River near Cape Girardeau, to Joliet, Illinois. Curtis Williams, foreman.

180 miles of 26-in. for Anderson Bros. on Trunkline job from Darnell, Louisiana, to Senatobia, Mississippi. Foreman, Ira Gould.

54 miles of 20-in. for Bechtel Corporation from Wood River to Patoka, Illinois, on Ohio Oil Company job. Ray Herron, foreman.

50 miles of 12-in. for Great Lakes Pipe Line Company system, Pacific Pipeline and Engineers, Ltd., contractor, from Humboldt to Independence, Kansas. R. E. Miller, foreman.

42 miles of 6, 8, and 10-in. gathering lines for Bills and Troth in South Dakota and Iowa, one location being at Vermillion, South Dakota, and other at Fort Dodge, Iowa. This is on the Northern Natural Gas Company System. Jack Ellette, foreman.

100 miles of 6-in. for Wabash Construction Company, from Newark, Ohio, to South Charleston, near Dayton, Ohio, on Pure Transportation Company job. John Greer, foreman.

40 miles of unloading for Panhandle Eastern; 30-in. pipe Blissfield, Michigan, to Allen Park, Michigan. Foreman, O. C. York.

Bechtel-Price-Conyes, 220 Bush Street, San Francisco, California, completed in November the 506-mile, 34-in. pipe line between Topock, Arizona, and Milpitas, California, for Pacific Gas and Electric Company. R. L. Bowman was general superintendent of the work, M. V. Scott manager of the mainline office at Hollister, California, and Steve Valline administrative manager at San Francisco.

Williams-Austin Company, Grant Building, Pittsburgh, Pennsylvania, had completed approximately 60 per cent (by the middle of November) of the 21 miles of 20-in. being laid for New York State Natural Gas Corporation between Tonkin station and Bakerstown, Pennsylvania. The field office is at New Kensington, Pennsylvania. Ralph Gaddy is superintendent and E. E. Mayes timekeeper.

From North Means compressor station to Foster, Kentucky, 42 miles of 20-in. are being laid for Central Kentucky Natural Gas Company. This work was about 50 per cent completed. The field office is at Mt. Sterling, Kentucky. Leman Creech is superintendent and L. A. Franks timekeeper.

Vaughn and Taylor Construction Company, Inc., Box 1351, Wichita Falls, Texas, is installing a 99-mile gas gathering system in the Sherman field, Texas, for Phillips Petroleum Company. Size of the pipe is from 3 to 16 in.

A gathering system also is being laid for Sunray Oil Corporation. This is a 133-mile low pressure gas line to serve the Snyder gasoline plant in Scurry County, Texas. Pipe size is from 3 to 30 in. Work began October 30. D. D. Vaughn is superintendent.

Dunn Bros., 801 Mercantile Securities Building, Dallas, Texas, have contracted to string 471 miles of pipe for H. C. Price Company on the Texas Illinois Natural Gas Pipeline Company project, as follows:

Section 2—100 miles of 26-in. from Refugio to Glenflora, Texas.

Section 3—36 miles of 24-in. from Old Ocean, Texas, to the main line, and 36 miles of 12-in. from Chocolate Bayou to the main line.

Section 4—109 miles of 30-in. from Glenflora to Urbana, Texas.

Section 5—91 miles of 30-in. from Urbana to Dotson, Texas.

Section 6—99 miles of 30-in. from Dotson to the Texas-Arkansas state line.

Other jobs being strung by the company are:

El Paso Natural Gas Company—415 miles of 24-in. between Fruitland, New Mexico, and Yucca, Arizona. (San Juan line.)

H. C. Price Company (Tennessee Gas Transmission Company)—400 miles of 26-in. in Ohio, Pennsylvania, and New York. This job is 80 per cent completed (November 15) with crews now working in New York State.

El Paso Natural Gas Company—419 miles of 30-in. in New Mexico, Texas, and Arizona.

Smith Contracting Corporation, 205 Northwest Seventh Street, Fort Worth, Texas, will finish the first week in December its work in the Texas Gulf Coast area for Texas Eastern Transmission Corporation. This job consists of 108 miles of 16-in. between Baytown and Provident, Texas. Two spreads are working under the general superintendency of J. H. Smith. The spread working out of Eagle Lake has Jim McKnight as spreadman and Ivan Steele in charge of the office. Out of South Houston. H. E. "Shorty" Doyle is spreadman and M. E. Williams office manager.

Anderson Brothers Construction Company, 707 North Drennan Street, Houston, Texas has been clearing right-of-way on the 174-mile section of 24-in. between Garwood, Texas, and the Sabine River for Trunkline Gas Supply Company. The field office is at Liberty, Texas.

On the same system, 127 miles of 26-in. is being laid between Greenville and Senatobia, Mississippi. The field office is at Greenville with Lewis Knox superintendent.

Started earlier was 42 miles of 26-in. between Longville, Louisiana, and the Sabine River for Trunkline. Dick Jernigan is superintendent of this work, operating from DeQuincy, Louisiana.

J. L. Cox and Son, Raytown, Missouri, (stringing contractors), are stringing 232 miles of 16, 18, and 24-in. pipe in Mississippi and Alabama for Southern Natural Gas Company.

Between Dallas and Corsicana, Texas, 177 mile sof 8-in. pipe is being taken up and reconditioned by O. R. Burden Construction Company for The Texas Pipe and Supply Company, and this pipe is being hauled by J. L. Cox.

H. C. Price Company, Pipeline Division, P.O. Box 1111, Bartlesville, Oklahoma, has the general contract covering construction of 373 miles of 26-in. high pressure natural gas line for Tennessee Gas Transmission Company from the north bank of Ohio River, east of Portsmouth, Ohio, and northeastward to near Buffalo, New York. Work on initial section of nearly 220 miles through Ohio is completed. Work on 153-mile section through Pennsylvania and New York was 90 per cent completed as of November 10 and scheduled for completion by the end of the month. Spreads are located as follows:

Corry, Pennsylvania, Box 289, Telephone 30284, G. A. Reutzel, superintendent; W. E. Yount, office manager; and these foremen: J. H. Hairston, right-of-way; L. J. Loncarich, ditch; J. C. Anderson, bending; H. C. Morrison, pipe; K. N. Adkins, pipe; R. W. Orr, welding; S. J. Wood, coating; A. L. Bell, lower-in; T. E. Walker, clean-up.

Dunkirk, New York, Box 177, Telephone 7944, R. K. Shivel, superintendent; R. E. Burgess, office manager; and following foremen: J. D. White, right-of-way; W. H. Olrich, ditch; J. H. Latham, bending; C. E. Shivel, pipe; R. L. Ezell, welding; U. M. Beaver, coating; G. E. Beaver, lower-in; Sam Price, clean-up; Ray Drewell, crossing.

Construction of approximately 480 miles of main transmission line for Texas Illinois Natural Gas Pipeline Company from near Refugio, Texas, and extending northeastward to the Texas-Arkansas state line near Texarkana. Work on 36 miles of 24-in. extension to Old Ocean field near Hungerford completed; work on 110 miles of the main 30-in. pipe line between Hungerford and Texarkana 50 per cent completed as of November 10. Contract also includes 38 miles of 12-in., 97 miles of 26-in., and an additional 200 miles of 30-in., plus multiple crossing of Trinity River. The 12 and 26-in. sections have been subcontracted to Western Pipeline Constructors, Inc. Spreads situated as follows:

Wharton, Texas, General Delivery, Telephone 925: W. B. Williams, superintendent; P. O. Rutledge, office manager; and these foremen: R. H. Edwards and D. L. Beachy, right-of-way; K. K. Kelly, ditch; Roy Stegall, bending; J. I. Cobb, pipe; C. F. Jones, welding; Rube Owens, coating; A. D. Hamilton, lower-in; Fred Williams, clean-up.

Tomball, Texas, General Delivery, Telephone 280: C. R. Ice, superintendent; G. A. Harvey, office manager; and the following foremen: John E. Hamilton and Jessie Cash, right-of-way; E. W. Whisenant, ditch; Forest Loinette, bending; W. T. Dickerson, pipe; L. O. Reutzel, welding; N. D. Adams, coating; J. C. Rich, lower-in; E. D. Worley, clean-up.

Williams Brothers Corporation, National Bank of Tulsa Building, Tulsa, Oklahoma, has been awarded the contract to lay the 707 miles of loops that will parallel Plantation Pipe Line Company's system from Baton Rouge, Louisiana, to Charlotte, North Carolina. The pipe will be of 18-in. diam from Baton Rouge to Bremen, Georgia (432 miles), and 14-in. from that point to Charlotte (275 miles). The project is expected to get under way this month. Several spreads will be employed.

O. R. Burden Construction Corporation, Box 5216, Tulsa, Oklahoma, is taking up and reconditioning 177 miles of 8-in. pipe between Corsicana and Dallas for Texas Pipe and Supply Company. The field office is at Waxahachie, with Floyd Lewis superintendent and J. S. Burden office manager.

Between Sweeny and Webster, Texas, 51 miles of 6 and 8-in. pipe are being laid for Phillips Pipe Line Company. Barney C. Hall is superintendent over the job and Howard Smith manager of the field office at Alvin.

R. H. Fulton and Company, Box 1526, Lubbock, Texas, is laying 155 miles of 20-in. between Jetmore and Bushton, Kansas, and 73 miles of 26-in. from Concordia to Salina, Kansas, for Northern Natural Gas Company. Jerry Nash in superintendent in charge of the former job, and M. L. Boyd of the latter.

Work also is under way on 184 miles of 26-in. for Trunkline Gas Supply Company between Senatobia, Mississippi, and Joppa, Illinois. Ed Veach is superintendent and Bill Gray field office manager.

Clark Williams is general superintendent over all three jobs.

Fulton and J. T. Brodie, as a joint venture, are laying 264 miles of 20-in. for Trunkline from McAllen to Altair, Texas. J. T. Brodie is in charge of the work. The field office is at El Campo.

A new contract is for the laying of 56 miles of 12¾-in. pipe between Wichita Falls, Texas, and the Chico pump station in Wise County for The Texas Pipe Line Company.

Bechtel Corporation, 220 Bush Street, San Francisco, California, has begun work on its portion of the Texas Illinois Natural Gas Pipeline Company system. This consists of 409 miles of 30-in. in Arkansas and Missouri. Operations at present are near Newport, Arkansas. The field office is at 409 East Markham Street, Little Rock, Arkansas. E. W. Davis is project manager, A. M. Berlander general superintendent, and E. C. Elting office manager.

Work also has begun on 54 miles of 20-in. crude oil line in Illinois for Ohio Oil Company. An office has been opened at 1360 St. Louis Boulevard, Vandalia, Illinois. S. D. Bechtel, Jr is superintendent and W. H. Molander office manager.

Associated Pipe Line Contractors, Inc., 3272 Westheimer Road, Houston, Texas, is laying 161 miles of 16 and 18-in pipe in Alabama and Georgia for Southern Natural Gas Company.

Texas-Southern Contracting Company, 804 Dan Waggoner Building, Fort Worth, Texas, had about two weeks' work left (November 15) on the job it has been doing in Louisiana and Texas for United Gas Pipe Line Company. This project consists of 24 miles of 16-in. from Cameron Parish to the Gulf refinery at Port Arthur, Texas. The remaining work is all inside the refinery. F. O. "Banty" Traweek is superintendent and Q. B. Davis, Jr., office manager.

The Transcontinental job in South Texas has been completed.

Houston Contracting Company, 3272 Westheimer Road, Houston 6, Texas, has begun work on its contracts with Trunkline Gas Supply Company. One spread is laying 50 miles of 26-in. from the vicinity of Longville, Louisiana, northeast to a point near Hineston, Louisiana. DeRidder, Louisiana, is the present field headquarters. W. H. Hayes is superintendent, J. C. Strickler and J. B. Stoddard office.

Between Longville and Lacassine, Louisiana, another spread is laying 33 miles of 20-in. Headquarters are at Kinder. F. A. Silar is the superintendent and C. V. Oliver and L. F. Redfearn are in the office.

From Lacassine to a point near Lake Arthur 18 miles of 16-in. are being laid by a crew supervised by H. L. Leake. S. B. Harrison is managing the field office at Welsh, Louisiana.

The company is well along on the 126 miles of 26-in. being laid for Trunkline from Epps to Hineston, Louisiana. Headquarters are at Olla with E. C. Norris the superintendent and R. J. Axsom office manager.

Work recently got under way on two 16-in. lines across the Mississippi River for Tennessee Gas Transmission Company. The lines are being laid in the vicinity of the Greenville, Mississippi, bridge, and field headquarters are at that place. H. E. Murphy is superintendent and J. J. Nolan office manager.

Oklahoma Contracting Corporation, 1210 Mercantile Bank Building, Dallas, Texas, is working on a 17-mile lateral to Paterson, New Jersey, for Transcontinental Gas Pipe Line Corporation, consisting of 8.5 miles of 30-in. and 8.5 miles of 10-in. Jobs for Tennessee Gas Transmission Company in Mississippi, Transcontinental in South Texas, and Texas Eastern Transmission Corporation near Little Rock, Arkansas, were completed recently.

Midwestern Constructors, Inc., 105 North Boulder Street, Tulsa, Oklahoma, has contracted four "Schedules" and one river crossing on the Texas Illinois Natural Gas Pipeline Company system. The job was kicked off November 3 on Schedule 1, which consists of 100 miles of 26-in. between LaGloria and Refugio, Texas. A field office has been opened at Kingsville. M. T. Wilhite is superintendent and Denver Franklin assistant superintendent.

Schedule 11, consisting of 100 miles of 30-in. from the Mississippi River near Chester, Illinois, to Effingham, Illinois, has been under way for some time and to November 13 was approximately 20 per cent completed. The field office for this work is at DuQuoin, Illinois. R. C. Stanley is superintendent, John Work spreadman, and Mac Hoffman assistant spreadman.

Schedules 12 and 13 will not begin until sometime in 1951. Schedule 12 is 100 miles of 30-in. from Effingham to Sibley, Illinois, and Schedule 13 is 92 miles of 30-in. from Sibley to Joliet, Illinois.

The contracted river crossing is of the Illinois near Morris, Illinois.

Scheduled for completion December 1, was the station additions at Sioux City, Iowa, for Great Lakes Pipe Line Company. F. C. Snavely has been in charge of this work.

Arabian Bechtel Corporation, 220 Bush Street, San Francisco, California, is handling construction of the 566-mile pipe line from Kirkuk to Baniyas for Iraq Petroleum Company, Ltd. Clark Rankin, vice president of Bechtel, is project manager.

Trojan Construction Company, Inc., P.O. Box 4427, Oklahoma City, Oklahoma, announces a new contract with Oklahoma Natural Gas Company to lay 52 miles of 26-in. from Edmond to Depew and 40 miles of 16-in. between Ninnekah and County Line. The starting date has not been scheduled.

The contractor is taking up 284 miles of 6⅝-in. pipe between Hagerstown, Indiana, and Charlestown, Ohio, formerly owned by Sohio Pipeline Company. The job is approximately 70 per cent completed (November 15). The field office is now at Galion, Ohio, and W. E. "Slim" Deaver is superintendent.

The job of taking up, reconditioning, and laying 40 miles of 10-in. for Shell Pipe Line Corporation near LaGrange, Texas, is almost completed. On November 15 the work was 90 per cent finished. E. L. "Tex" Maggard is superintendent.

Scheduled for completion about December 15 is the laying of 50 miles of 8⅝-in. from the Trawick field to Longview, Texas, for Humble Pipe Line Company. Charles T. "Swede" Tillotson is in charge.

H. L. Gentry Construction Company, 921 Michigan Avenue, Jackson, Michigan, is making progress on the 126 miles of 8⅝-in. pipe it is laying for Susquehanna Pipe Line Company between Toledo, Ohio, and Sarnia, Canada. The job has been divided among two spreads. One spread is constructing 65 miles from Toledo to Birmingham, Michigan. The field office is at Flat Rock, Michigan, with James G. Mitchell superintendent. The other spread is working out of Utica Michigan, to lay the 61 miles from Bloomfield Hills, Michigan, to Sarnia Frank Morris is superintendent.

Sheehan Pipe Line Construction Company, 529 National Bank of Tulsa Building, Tulsa, Oklahoma, had completed 40 per cent (November 13) of the 32 miles of 16-in. being laid for Southern Natural Gas Company between Wetumpka and Tallassee, Alabama. The 180 miles of 18-in. for the same company from Gwinville, Mississippi, to Selma, Alabama, was completed recently.

Latex Construction Company, 2707 Ferndale Place, Houston, Texas, is doing the following work:

For Tennessee Gas Transmission Company, 95 miles of 20-in. from Natchitoches to Kinder, Louisiana. F. A. Silar is superintendent and the spread is working out of Glenmora. C. V. Oliver and L. F. Redfearn are in the office.

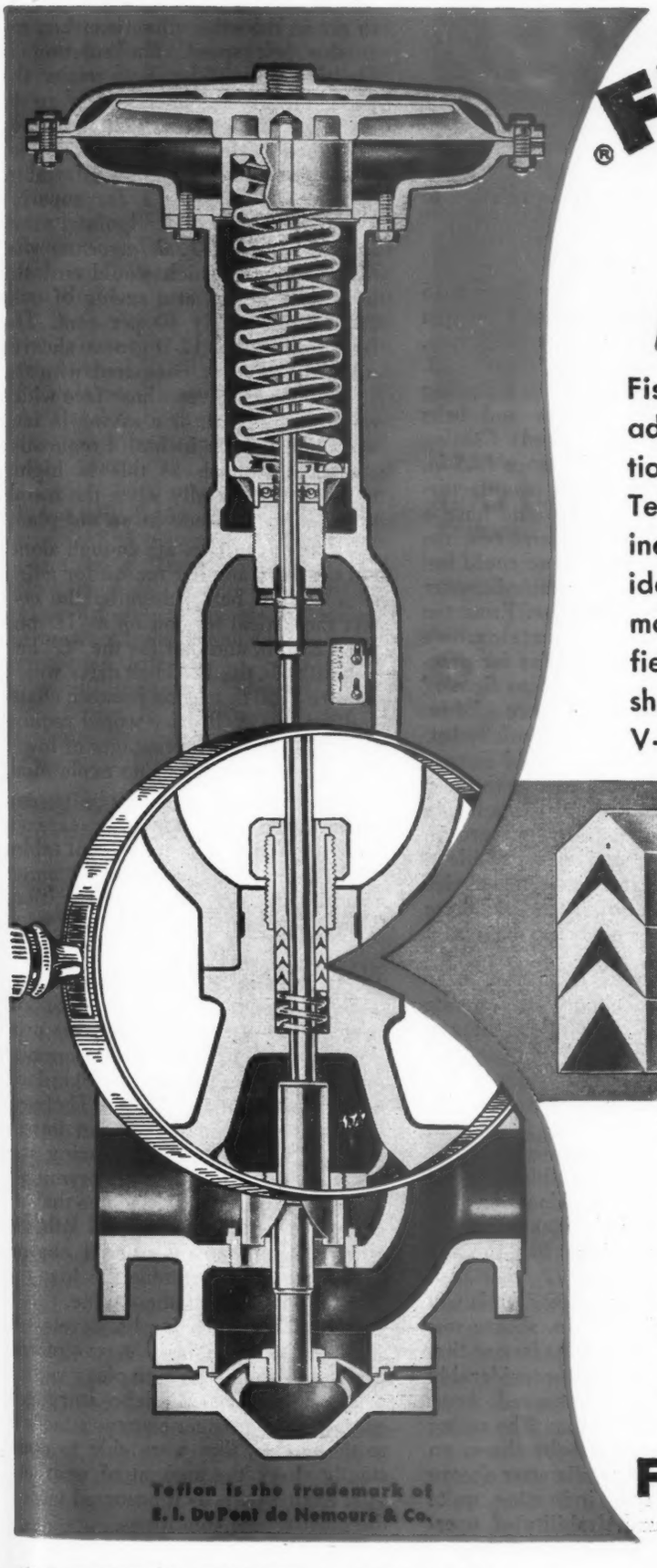
Also for Tennessee Gas, 102 miles of 16-in. from Bayou Sale to Kinder. Three spreads are working on this project. H. L. Leake is superintendent of one and S. B. Harrison is office manager. On another spread W. H. Hayes is superintendent and J. C. Strickler and J. B. Stoddard are in the office. J. A. Cantrell is supervising the third spread, which is working out of Elton. A. E. Stremmel is the office manager.

Two 16-in. submarine lines are laid across the Mississippi River for Tennessee Gas. The installation is being made just below the Greenville, Mississippi, bridge. H. E. Murphy is superintendent and J. J. Nolan manager of the field office, which is in Greenville.

Texas-Louisiana Construction Company, 804 Dan Waggoner Building, Fort Worth, Texas, is laying 50 miles of 30-in. for United Gas Pipe Line Company from Missouri City to a point near Wharton, Texas. The contractor is working two spreads, one making its headquarters at Rosenberg and the other at Wharton. The job kicked-off the middle of November and is scheduled for completion in 30 days. "Borger Red" McMenamy is superintendent at Rosenberg and Robert Yater office manager. At Wharton Jimmy Reid is superintendent and Pat Rogan office manager.

Reese Brothers Construction Company, Hugoton, Kansas, to the middle of November had completed 70 miles of the gathering system it is laying for Northern Natural Gas Company in the Hugoton gas field. A total of 99 miles of 4, 6, 8, and 10-in. will be laid. Paul Reese is general superintendent, Edd Reese spread foreman, Gale Reese welding foreman, and Chet Beighle is in charge of the office.

IT'S *New* AND A *Natural*



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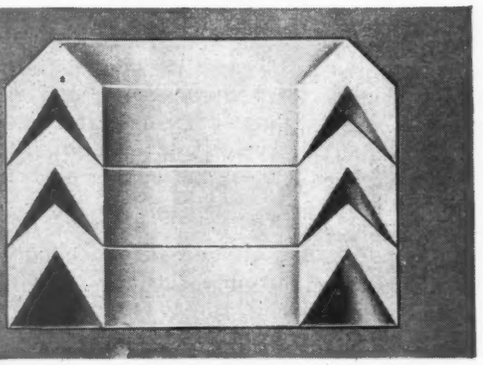
Fisher Teflon V-ring Packing has been adopted as standard available construction for all Fisher diaphragm motor valves. Teflon is tough, resilient, and chemically inert. Its smooth soap-like surface makes it ideal packing for control valves. After more than two years of laboratory and field testing Teflon in various forms and shapes, Fisher engineers decided upon the V-ring construction as ideal for packing.



Fisher Teflon packing cut in section to show V-ring construction.

Advantages of Fisher Teflon V-ring packing:

- ***Economical***
- ***Minimum leakage***
- ***Low maintenance***
- ***Reduction of packing friction***
- ***No corrosion***
- ***No product contamination***

Teflon is the trademark of E. I. DuPont de Nemours & Co.

FISHER GOVERNOR CO.

MARSHALLTOWN, IOWA

Better V-Belt Drives for Less Money

F. J. DONAHUE*

MANY times it is possible to figure a drive that is much better and surprisingly less expensive than another for the same job. In other words, a first solution of a drive problem is not always the best, and it can often be improved by study and calculation. Basically, however, there is one consideration that is the key to most such improved drives. This is the matter of small sheave pitch diameter.

Flexing a rubber V-belt around a sheave of too small pitch diameter will cause excessive heating, rapid wear, and early failure of the belt. Certain pitch diameters have long been recognized by the V-belt drive industry as minimums below whi h it is unwise to go. These minimum pitch diameters are as follows:

A belts, 3.0 in.; B belts, 5.4 in.; C belts, 9.0-in.; D belts, 13.0-in.; E belts, 21.6-in.

Further in this regard, a study of V-belt rating tables will demonstrate that the use of small diameter sheaves penalizes a drive in two ways: First, for a given rpm, the smaller sheaves produce a lower belt speed and consequently a lower horsepower rating; second, for a given belt speed the smaller sheave produces a lower horsepower rating than at a larger sheave at the same belt speed. Continuing to study the belt rating tables, it will also be noted that on small diameter sheaves there is a further penalty suffered—namely, at higher belt speeds no ratings are shown. Thus one is subtly discouraged from using very small diameter sheaves at higher speeds. This merely reflects the fact that harmful as it is to operate very small diameter sheaves at moderate speeds, it becomes rapidly more harmful at higher speeds.

To illustrate these points in a practical way, we shall review two quite dissimilar problems from the standpoint of a run-of-the-mill, perfunctory solution and then from the standpoint of a more careful, considered approach deliberately avoiding too-small diameter sheaves in relation to the belt section used:

Case 1

Required a V-belt drive from a 15 hp normal torque motor at 1750 rpm to a centrifugal blower at 1272 rpm. The ratio is between 1.37 and 1.38. Without much thought, the following drive with stock sheaves and belts would probably be quoted: *Catalog 6-B46-5.4-7.4 Center Distance 13.5 in.* According to this recent manufacturer's catalog, this drive would have a total rating of 18.2 hp and cost the user $40.48 net. Now, if we could improve the small sheave pitch diameter it would improve the drive. From the same manufacturer's catalog, we could work out a stock drive for practically the same ratio such as *Catalog 5-B55-6.8-9.4 Center Distance 15.4 in.* This drive would be substantially better than the other. It would have a total rating of 22 hp and cost the user only $36.81 net. Thus, by using larger sheaves we save one belt, one groove on each sheave, and still provide a larger horsepower capacity at a price some 10 per cent lower than the drive using the smaller diameter sheaves.

Case 2

Required a V-belt drive to operate from a 100 hp wound rotor motor at 870 rpm to a centrifugal pump at 1600 rpm. From observation, we know that some would feel compelled to use "D" section belts in this drive in view of the horsepower requirements of the job. However, in their well-intentioned and quite justified avoidance of belt speeds much beyond 5000 fpm, they would quote something like the following drive: *Catalog 12-D173-22.0-12.0 in. center distance 60.7 in.* It will be found that the 12.0 in. sheave was selected because it was the largest that could be used without considerably exceeding 5000 fpm belt speed. Actually it produces 5040 fpm. The rating table for "D" section belts shows no ratings for a 12.0 in. diameter sheave beyond 3800 fpm indicating quite definitely the undesirability of operating "D" belts on a 12.0 in. sheave beyond 3800 fpm. This drive would cost a user $636.84 net.

Studying such a drive with an eye to bettering it, the 12.0 in. sheave would claim our attention at once. It is a full inch smaller than the minimum generally regarded as acceptable. Yet, to select a larger sheave would be to err in the other direction; i.e., excessive belt speed. The solution is really simple. Why not retain the present sheave diameters but go to the next smaller belt section namely "C" section, for which the 12.0 in. diameter is generous and comfortable. This would give us a far superior drive from several standpoints: *Catalog 11-C173-22.0-12.0 in. center distance 60.5 in.* which would cost the user $283.03 net, at a saving of over $250.00 or nearly 40 per cent. The face width of the 12-D groove sheaves would be $17\frac{9}{16}$ in. compared with the 11-C groove sheaves whose face width would be $11\frac{3}{8}$ in. or a saving in face width of over 6 inches. Frequently, compactness such as this is highly important, especially when the installation is to be made in an old plant.

These advantages are enough alone, but consider another reason for going to a smaller belt. Assuming the correct theoretical tension on a "D" belt to be 230 lb, and that for the "C" belt to be 125 lb, the 12-D belt drive would require 2760 lb tension between shafts and the 11-C belt drive would require only 1375 lb. The advantages of lower bearing pressures need no explaining.

These examples are given to emphasive the need of using care in selecting drives. The convenient tables worked out for the catalogs cannot take all factors into consideration. That is left to the engineer. * * *

*Application Engineer, Allis Chalmers Manufacturing Company, Milwaukee, Wisconsin.

New Motor Oil Developed

Development of a new motor oil perfected by use of radioisotopes produced by the Atomic Energy Commission has been announced by Standard Oil Company of California. The new oil will be put on the market immediately, Standard said, replacing the company's present RPM premium-type lubricant. Standard states that as compared with conventional oils, it will cut wear-rate of critical engine parts in half, and double the low-oil-consumption life of the engine.

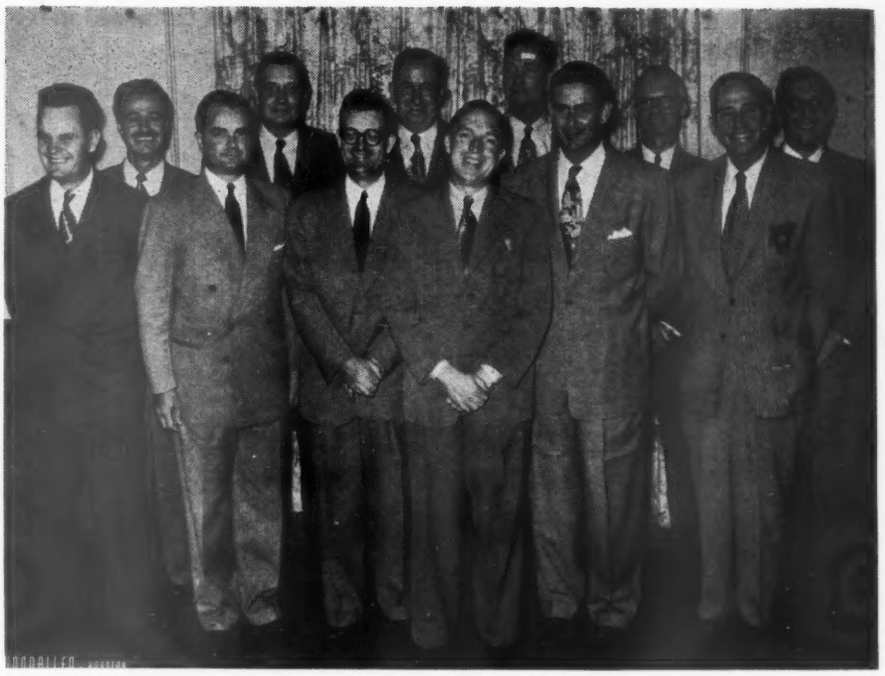
Research engineers who developed this new lubricant used a revolutionary test method which employs radioactive piston rings in a laboratory test engine. With a Geiger counter attached to the engine, they were able to constantly check the amount of wear on vital engine parts as it occurred under the most severe conditions.

NEWS

Film on Killing Wild Well Shown Nomads

At the October meeting of the Houston Nomads in Houston, Texas, the Humble Oil and Refining Company's color film, "Danger Lurks Below", was shown and a personal touch was added to the interesting movie by the presence of Frank Bass of Humble, who was one of the engineers working on the killing of the wild well shown in the picture.

Foreign and domestic visitors at the Nomads meeting shown in the photograph are: Front row, Cecil Laws, Baash-Ross Tool Company, Houston; Judson D. Lowd, Parkersburg Rig and Reel Company, Houston; Francis G. West, Asiatic Petroleum Corporation, Houston; John H. Edwards, Anglo-Iranian Oil Company, Masjid-I-Sulaiman, Abadam, South Iran; W. A. Randel, Rockwell Manufacturing Company, Houston; Henry W. Pullman, Baker Oil Tools, Inc., Los Angeles; back row, Pedro de Garay, Baker Oil Tools, Mexico City, Mexico; E. L. Evenson, A. O. Smith Corporation, of Texas, Houston; Frank Bass, Humble Oil and Refining Company, Houston; Don Meek, Mexican-American Independent Oil Company, Houston; John A. G. Scott, AIOC, Masjid-I-Sulaiman, Abadam, South Iran; Alan H. Baldwin, Trinidad Petroleum Development Company, Ltd., Palo Seco, Trinidad.



Houston Nomads and visitors at October meeting.

Anglo, Socony Protest Egyptian Oil Law

Anglo-Egyptian Oilfields Ltd. and Socony-Vacuum Oil Company have discharged 1000 employees as a result of the stringent customs ruling passed by the Egyptian Government recently. The Government is prepared to requisition and exploit all wells, and has set aside $2,500,000 for the purchase of equipment for a new Government-owned refinery at Suez. Ambassadors of U.S., U.K., and France have lodged complaints with the Government against the new law, aimed at preventing war shipment to Israel.

Shell Gets Lab Staff

Scientists and technicians from 135 American and 13 foreign universities and colleges staff the new consolidated laboratory for oil and chemical research dedicated recently by Shell Development Company in Emeryville, California. Shell development is the research affiliate of Shell Oil Company. Making up the staff of the research center are physicists, chemists, mathematicians, engineers, and many other scientific specialists.

Texas Oil Allowable Is Reduced for Third Month

Texas is producing less crude oil this month for the third consecutive month. The Railroad Commission has cut the permissible crude oil production in Texas by 160,083 bbl a day, the sharpest cut of the year. This makes the total permitted output in December 2,556,944 bbl daily, about 268,000 bbl a day below the peak "allowable" set in Texas for last September. Part of the sharp production decrease was due to results from the ratio of one less producing day to one additional calendar day, compared with the 30-day month of November.

Oil Products Up in U. S., Reduced in Canada

Prices on most petroleum products have been boosted during the past month. Standard Oil Company (Ohio) and Ohio Oil Company have upped their prices on home heating oils and kerosine in Ohio, except in Toledo. Ohio Standard increased its retail price of No. 1 home heating oil by 0.4-cent a gallon and No. 2 home heating oil by 0.2-cent. Its kerosine price went up 0.4-cent a gallon. Standard Oil (Indiana) has raised its price of home heating oil and kerosine ½-cent a gallon.

Imperial Oil Company has reduced its prices of kerosine and light fuel oils in most of Manitoba and Saskatchewan. Reductions in wholesale gasoline and kerosine prices range up to about four cents a gallon and in light fuel oils to about one cent a gallon.

Gasoline has dropped for the third successive month as a result of the end of vacation period. The average retail price of regular gasoline-ex-taxes—as of November 1 was down to 19.92 cents a gallon from 20.11 cents on the first of October. The high was reached last August 1 when the price stood at 20½ cents.

Union Oil of California has announced an increase in its posted price for heavy crude oil. Increases range from 25 cent a barrel for 14 gravity oil to no increase for oil above 25 gravity.

To Enlarge Drake Museum

A proposal has been made to raise $1,000,000 within the oil industry to enlarge Drake Well Museum and Memorial Park at Titusville, Pennsylvania, in time for celebration there in 1959 of the 100th anniversary of the well. Dr. P. H. Giddens, curator of the state-owned museum, presented the plan to the board of directors of the Pennsylvania Grade Crude Oil Association at a regular meeting. The board authorized Association president C. E. Streeter of Bradford to appoint a small committee to support the project.

Research Institute Is Host

Southwest Research Institute held open house at Essar Ranch in San Antonio, Texas recently. Laboratories of the Institute were opened for inspection, and special demonstrations of research facilities and technical equipment was arranged. The Institute has offices in San Antonio, New York, and Paris, France.

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Committee Named for World Petroleum Congress

The National Committee for the USA for the Third World Petroleum Congress Meeting in The Hague on May 28-June 6, 1951 has completed its organization as follows: E. V. Murphree, Standard Oil Development Company, chairman; F. S. Clulow, Shell Oil, vice chairman; Paul D. Foote, Gulf Research and Development, vice chairman, and K. C. Mackenzie, The Texas Company, secretary.

Membership of the executive committee is as follows: Earl Bartholomew, Ethyl Corporation, W. F. Faragher, Houdry Process Corporation, and the officers. The membership committee at the present time is:

R. C. Alden, Phillips Petroleum; A. H. Bell, Natural Resources Building, Urbana, Illinois; Earl Bartholomew, Ethyl Corporation; J. E. Brantly, Drilling and Exploration Company, Inc.; F. S. Clulow, Shell Oil Company; W. F. Faragher, C. G. Kirkbride, Houdry Process Corporation; Paul D. Foote, Gulf Research and Development Company; A. P. Frame, Cities Service Research and Development Company; J. R. Keith, California-Texas Oil Company, Ltd.; E. V. Murphree, Standard Oil Development Company; K. G. Mackenzie, The Texas Company; L. L. Nettleton, Gravity Meter Exploration Company; C. E. Reistle, Jr., Humble Oil and Refining; J. K. Roberts, Standard Oil Company (Indiana); M. E. Spaght, Shell Development Company, Inc., and H. G. Vesper, California Research Corporation.

Full Credit Given A & I Course

Texas A and I College at Kingsville, Texas has been given full accreditation in petroleum and natural gas engineering by the Engineers' Council for Professional Development. A and I thus becomes the only school in the South offering such accredited training. Pennsylvania State is the only other college in the nation known to offer the approved curriculum, Dr. Frank Dotterweich, director of the A and I division of engineering, said. The accreditation will mean that A and I graduates will be fully recognized in all states and can better meet requirements for receiving state professional engineers licenses.

Avgas Cut 65,000 Bbl

The supply of high octane military aviation gasoline was narrowed by 65,000 bbl during the week ending November 17, the National Petroleum Association has reported. The Armed Services Petroleum Procurement Agency, buying for the three military services, picked up an additional 43,000 bbl of grade 115/145 avgas and 22,000 bbl of grade 100/130 avgas during the week. The military agency is now short 421,000 bbl of grade 115 and 639,000 bbl of grade 100 on requirements for the 6 months ending December 31. Requirements for the period total 8,612,000 bbl of grade 115 and 8,824,000 bbl of grade 100.

Skelly Stations Honor Tide Water Credit Cards

Tide Water Associated Oil Company has made arrangements for holders of its national credit cards to use them at all stations of the Skelly Oil Company in the 17 Midwest and Rocky Mountain states in which that company markets petroleum products and automobile accessories, according to announcement by Eugene F. McCabe, vice president.

Quota Cut for Coke Field

The Texas Railroad Commission has ordered a 2759-bbl cut in allowables for the Jameson field, Coke County. The permitted flow rate will be 75 bbl per well, making 6032 bbl daily for the field. Wells will be exempt from shutdown until January 1, 195. The Commission issued the order so Sun Oil Company can test the effectiveness of a gas injection project for the field.

POWER

THE CLARK **HLA** PROVIDES:

SUPER POWER: 250-BHP per cylinder, 17″ bore, 19″ stroke.

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ECONOMY: High compression—low gas consumption.

LONG LIFE: Full precision bearings; oil-cooled piston heads and skirts.

SMOOTH BREAK-IN: Lubrized power pistons and power cylinders.

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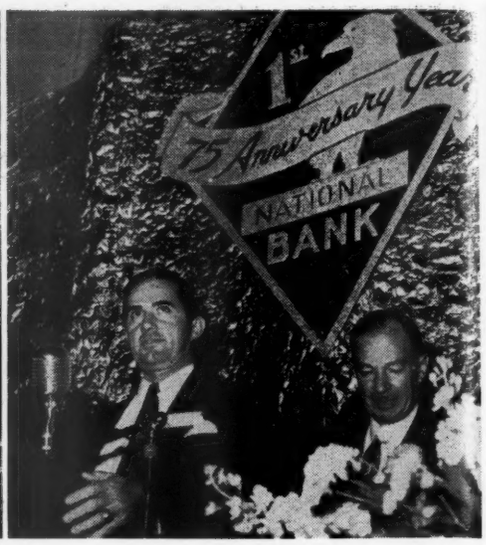


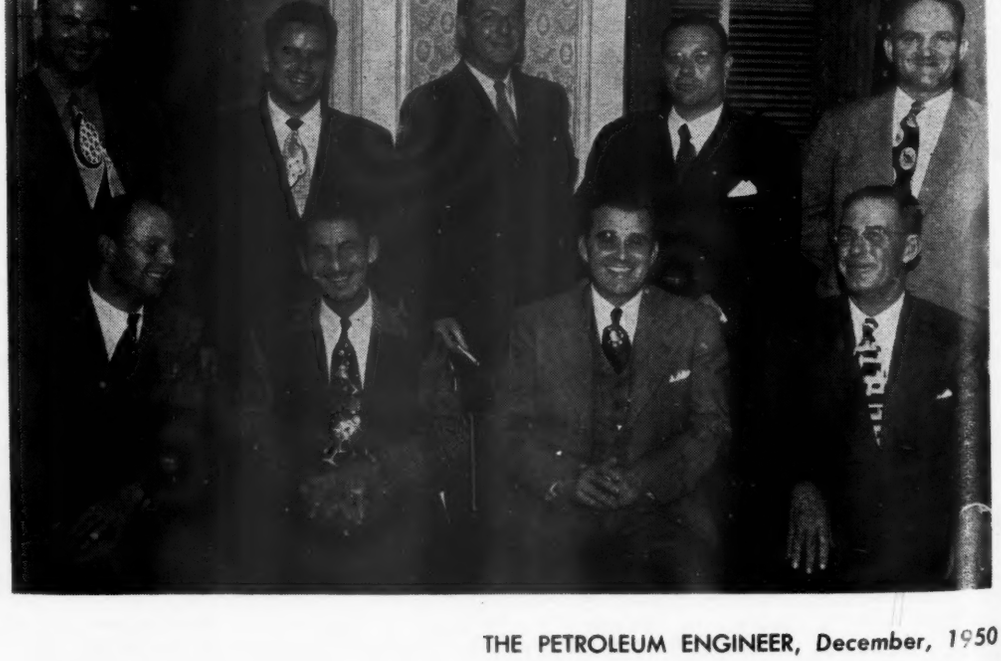
At the oil dinner given by the First National Bank in Dallas to celebrate its 75th anniversary were: Russel Brown, general counsel for Independent Petroleum Association of America; R. L. Foree, president, Texas Independent Producers and Royalty Owners Association; A. W. Thompson, president, American Association of Oil Well Drilling Contractors; Elliott V. Bell, editor, Business Week; Jake L. Hamon, president, Mid-Continent Oil and Gas Association; Ed Warren, president, Independent Petroleum Association of America. In the photo at the right are: Texas Governor Allan Shivers and the toastmaster, Eugene McElvaney, vice president in charge of oil department.

Dallas Bank Observes Its 75th Anniversary

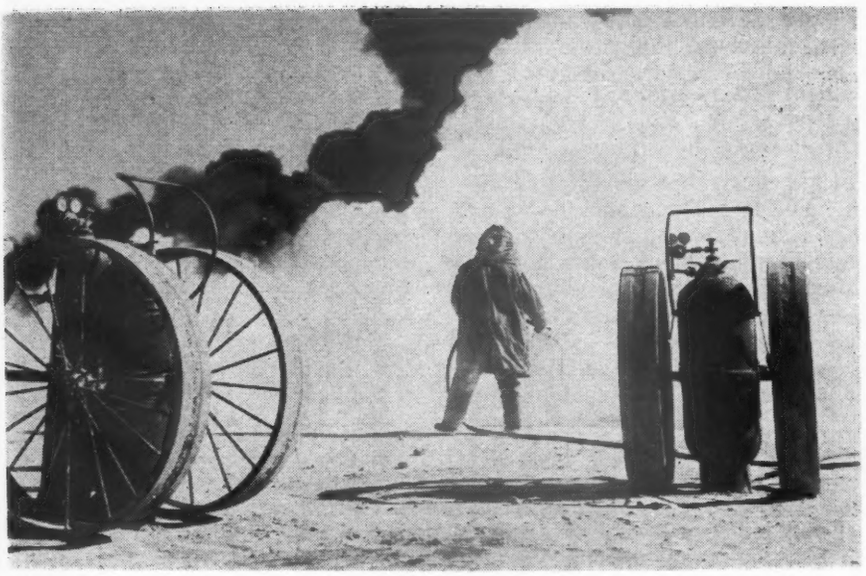
The First National Bank in Dallas, Texas observed its 75th anniversary recently. Beginning at 9 in the morning, friends and customers crowded the lobby of the First National to extend congratulations. Climax of the day's activities took place in the evening. The Crystal Ballroom of the Baker Hotel was the scene of a reception for the stockholders. Hundreds of stockholders passed the long receiving line of bank officers and directors and advisory directors. At the head of the line was Nathan Adams, honorary chairman of the board and dean of the Southwest's banking fraternity; Edgar L. Flippen, chairman of the board, and Ben H. Wooten, president. Present at the reception were several representing the fourth generation among the First National's stockholders. At last count, there were 2181 stockholders in all—more than 1300 of them living in Dallas. Other Texans number 506, living in 117 communities. The bank's other stockholders live in 33 states and one territory and in 6 other countries.

S. A. Petroleum Congress To Meet in Uruguay

The first South American petroleum congress will take place at Montevideo, Uruguay in March 1951. Active members of ISAP will be official members of the congress. The agenda includes the following: Geology and petroleum exploration, petroleum production, chemistry of petroleum, petroleum refining, transportation and storage of petroleum, consumption and utilization of petroleum products, economics of the petroleum industry, and other subjects.



Attend L. A. Nomads Meet. Present at the October meeting of the Los Angeles, California chapter of Nomads were: Standing, H. E. Allred, Socony Vacuum Oil Company, of Venezuela; James P. Carroll, Creole Petroleum; W. P. Barker, Anglo-Iranian; R. W. Coghill, Gulf Oil Corporation of Brazil; and W. J. Larson. Seated: Jean Lavaud, S. N. REPAL, France; Joe Kofahl, IPC; R. T. (Dick) Myers, Bahrein Petroleum, and C. C. (Mickey) Smart, Iraq Petroleum.



Flowing well on fire is saved by dry chemicals.

Dry Chemicals Extinguish Creole Petroleum Fire

Fire, which threatened to cause considerable damage to one of Creole Petroleum Corporation's oil wells in Venezuela, was checked by dry chemical extinguishers after it had raged unchecked for 5 hours. The well was producing through casing and tubing from two zones at 400 bbl per day. The casing production had 1250 psi flowing pressure, with gas oil ratio of 6600 cu ft per bbl. Tubing production had 1550 psi flowing pressure with gas oil ratio of 9700 cu ft per bbl. Tubing production was closed in at time of fire, with about 2000 psi closed in pressure on tubing. Master valve was open and valve on casing outlet was open. When the fire broke out at least two of the three ½-in. valves were open and supplying fuel to the fire.

When all other methods of fire fighting failed the water hoses were directed away from the fire, and 5 Ansul Chemical Company 150 extinguishers were opened and the hose crews advanced to the top of the earth mound and in some cases right up to the flaming wellhead as the extinguishing progressed. A short time later the fire was out.

Pakistan's First Oil Firm

The first oil company in the Moslem state of Pakistan has been formed and is named Messra Pakistan Petroleum Ltd., with capital of 70,000,000 rupees ($21,245,000), of which 40,000,000 rupees are of immediate issue. According to Pakistan's rules, the new company must offer 30 per cent of its shares to Pakistan nationals. The remainder has been purchased by the Burmah Oil Company, which has surrendered all its assets to the new company. Burmah Oil is a British firm.

The Pakistani government barred all exploration for oil by existing foreign companies in September 1949, until they accepted the rule requiring the offer of 30 per cent of their stock to Pakistani nationals. American companies found these terms unacceptable, but British companies accepted and agreed to build pipe lines and refineries after explorations. At least one more company is to be formed, replacing an existing British firm called Messra Attock Oil Company, Ltd., in Punjab.

Oil Earnings Increased For Third Quarter 1950

The majority of oil companies reporting net incomes for the first nine months of the year, have increased their earnings over the first nine months in 1949. The following table shows net income taken in during the period from January 1 to September 30, 1950 and 1949:

Company	1950	1949
Tide Water Associated Oil	$23,455,627	$20,200,956
Ohio Oil Company	28,225,031	26,734,727
Sunray Oil Corp.	14,145,000	7,273,000
Standard Oil Co. (Indiana)	87,334,000	71,728,000
Standard Oil of California	46,659,595	29,617,733
Lion Oil Company	14,861,400	6,422,441
Skelly Oil Company	19,954,254	19,537,772
Phillips Petroleum Company	35,885,522	32,684,852
Continental Oil Co.	12,555,794	8,301,178
Gulf Oil Company	83,200,000	73,295,000
Shell Oil Company	23,221,333	62,700,268
Sinclair Oil Corp.	46,902,416	40,447,645
Texas Pacific Coal and Oil	1,602,327	1,696,968
Atlantic Refining Co.	27,809,230	18,708,550

One company reported lower incomes for the third quarter of 1949. This was The Derby Oil Company, whose net income was $806,862.23, compared with $827,998.54 reported last year.

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PERSONALS

Temple W. Tutwiler, a director of Cities Service Company since 1930 and a member of its executive committee, died recently at his home in Birmingham, Alabama, after an extended illness. He was 71 years old. In 1930 he became a director of Cities Service and in 1936 an executive. Assigned the task of expediting the wartime construction of a great new refinery at Lake Charles, Louisiana, he did an amazing job in getting the Cities Service plant built and into production in time to play an important role in the war program. Known familiarly by his friends as "King Tut," Mr. Tutwiler held officerships and directorships in many important industrial and business organizations.

Milton S. Beringer has been appointed to the board of directors of The British American Oil Company Limited. Since joining B-A in 1934 as a refinery superintendent, Beringer has built several major refineries including those at Moose Jaw, Calgary, and Clarkson. He directed the recently completed expansion at Montreal East Refinery and, under his direction a new plant is being built at Edmonton and the existing refinery at Moose Jaw is being expanded.

Beringer has been superintendent of B-A's Turner Valley absorption plant and Calgary refinery. He was appointed manager of refineries in 1945 and later the same year assumed his present position of vice president in charge of manufacturing.

J. Bennett Hill, Sun Oil Company, Marcus Hook, Pennsylvania, and **Earl G. Gaylord,** of California Research Corporation, San Francisco have been awarded Certificates of Appreciation by the American Petroleum Institute's Research Committee. Awards were given to the men by Robert E. Wilson, chairman of the board of Standard Oil Company (Indiana), and chairman of the research committee of the API board of directors.

Theodore Gothier Quintal, 39, counsel for Socony-Vacuum Oil Company, Inc., died suddenly recently. He attended Lawrenceville School, was graduated from Yale in 1932, and from the Yale Law School in 1935. Following graduation he became associated with the New York law firm of Milbank, Tweed, Hope, Hadley and McCloy. He joined Socony-Vacuum in 1946 after serving with the U. S. Navy from 1943 to 1946 as a lieutenant.

Emil J. Senne of Baldwin, L. I., who retired in 1939 after 48 years with the Socony-Vacuum Oil Company, Inc., received a Certificate of Merit from the American Petroleum Institute recently in Chicago, Illinois, for his efforts in accident prevention in Soconoy-Vacuum and throughout the oil industry. The presentation was at a meeting of the National Safety Council. Senne instituted an accident prevention program in 1907 while superintendent of ship repairs at the Empire Yard, Long Island City, N. Y., of the Standard Oil Company of New York. As a charter member, Senne assisted in founding the National Safety Council in 1913.

Basil Kantzer, formerly manager of field operations for the Pacific Coast division of Union Oil Company of California, has been named manager of a newly-created natural gas and gasoline department. He will be responsible for all matters concerning natural gas and its products, either produced by or purchased by the company. **Kenneth C. Vaughan,** formerly division superintendent, Valley division, has been appointed manager of field operations, Pacific Coast division.

Kantzer joined Union Oil's field department as roustabout at Santa Fe Springs in 1934 after graduation from Stanford University. In the following years, he was a production engineer and production foreman at Santa Maria; district production foreman, Bakersfield, and chief production engineer in the Los Angeles head office. A graduate of the University of Southern California, Vaughan joined Union Oil in 1933. Beginning as a roustabout at Santa Fe Springs, he successively became maintenance foreman, production foreman, and production superintendent.

Arthur M. McQuiddy, former executive secretary of the New Mexico Oil and Gas Association, has joined the staff of the Western Oil and Gas Association as a public relations field representative. His particular function will be to coordinate the activities of the more than 100 area committees organized in connection with the Association's public relations program in the five western states. Prior to joining the New Mexico Oil and Gas Association, where he served as executive secretary for three years, McQuiddy had been editor of the Roswell, New Mexico, Morning Dispatch. He formerly worked for the Associated Press in Kansas City and for the Kansas City Star. He is a graduate of the University of Missouri and of the Kansas City Art Institute.

Walter C. Teagle

Walter C. Teagle, former president and chairman of Standard Oil Company (New Jersey), has been given the American Petroleum Institute's Gold Medal for Distinguished Achievement. Formal presentation of the gold medal was made at the API's 30th annual meeting in Los Angeles. Teagle, now in his 73rd year, was the chief executive officer of Standard Oil Company (New Jersey) for a quarter of a century beginning with World War I. He also was one of the charter members and founders of the American Petroleum Institute in 1919.

As the fifth recipient of the API gold medal, the retired oil-company executive joins the company of J. Howard Pew, director and former president of Sun Oil Company; Dr. Charles F. Kettering, the internationally-famed scientist; Dr. William Burton, former president of Standard Oil Company (Indiana), and the late Henry Ford.

Since his retirement, Teagle has maintained an office in the RCA building in New York, where he oversees the Teagle Foundation. This is an organization, which he set up for helping boys and girls to get higher education. The foundation, although still young, already has granted 150 scholarships, in addition to its other charitable activities.

Everett F. Wells, vice president of sales for Ashland Oil and Refining Company, has been elected executive vice president. Wells joined the company in 1925 as its first salesman, according to Paul G. Blazer, chairman of the board.

Paul Kayser, Houston, Texas was elected president of the Independent Natural Gas Association of America. He is president of the El Paso Natural Gas Company.

▸ **T. A. Aldridge** has been appointed director of industrial relations of the American Oil Company and **James K. Eagan, Jr.,** as general counsel. Both appointments also include the same posts for the company's subsidiaries, the Lord Baltimore Filling Stations, Inc., and the Mexican Petroleum Company of Georgia.

Aldridge joined the company in 1933 and was named sales manager of the southcentral region last year after having served for 12 years as division manager of the Carolinas. He is a graduate of Duke University and the Harvard School of Business Administration. Eagan has been with the company since 1937. Following his discharge as Navy lieutenant in 1946, he was appointed an attorney for the Pan American Petroleum and Transport Company in New York. He is a graduate of The Johns Hopkins University, Harvard Law School and School of Business Administration.

▸ **John Dupree,** representing Socony-Vacuum Oil Company, New York, was elected 1951 Chairman of the Oil Industry Information Committee. He succeeded **George H. Freyermuth,** manager of the public relations department of Standard Oil Company (New Jersey), the 1950 Chairman.

Vice chairmen elected were: Eastern region, Walter E. Black, Esso Standard Oil Company, Philadelphia, Pennsylvania; Middlewest, Charles Z. Hardwick, The Ohio Oil Company, Findlay, Ohio; Gulf-southwest, Charles Simons, Texas Mid-Continent Oil and Gas Association, Dallas, Texas; and West Coast, Haines Finnell, Union Oil Company of California, Los Angeles.

John Cooke of the American Petroleum Institute, New York, was elected secretary.

▸ **Charles F. Watson** has retired after 50 years continuous service as a tax accountant in Tide Water Associated Oil Company's New York office. At a special luncheon in his honor by company executives at the Whitehall Club he was presented with a watch by B. I. Graves, vice president. He joined the company in 1899.

▸ **Robert W. Linehan,** manager of natural gasoline division and crude oil sales, was appointed vice president of Anchor Petroleum Company.

▸ **Ovel L. Gregory** has been appointed to the staff of the Coastal Oil Company, Newark, New Jersey. Gregory comes to Coastal with a background of nearly 20 years in the petroleum industry, during which time he has been engaged in operations, marketing, and distribution of heating oil in the New York Harbor area.

▸ **C. E. Murray** of Bartlesville, Oklahoma, vice president and secretary of Cities Service Oil Company (Delaware) and affiliated companies will retire on January 1, according to an announcement by A. W. Ambrose, president. Upon retirement Murray will have completed almost half a century of active service with the company. Shortly after the turn of the century he joined the Denver Gas and Electric Company. In 1909 Murray was transferred to Joplin, Mo., where he served as auditor and chief accountant of the Empire District Electric Company. Five years later he became secretary of Toledo Railways and Light Company. In 1917 Murray came to Bartlesville, as secretary of the Empire Companies, which later became Cities Service.

▸ **Arnold G. Shipp,** of Maplewood, New Jersey, has been named assistant treasurer and general credit manager of its Eastern division by Tide Water Associated Oil Company, to succeed **Samuel J. Kane,** who has retired after serving with the company for 29 years. Shipp has been with the company for 23 years, having begun in the San Francisco office in charge of wholesale credits after 8 years with Chase National Bank, New York.

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BIBLIOGRAPHY—Classified list of important papers for 1949 - 1950

Classification by Authors

Sherwood, P. W., From Synthetic Fuels, What Chemicals!, Chem. Eng. 56, 99-101, Sept., 1949.

Sherwood, P. W., Aldehydes from Hydrocarbons, Petr. Processing 4, 794-800, July, 1949.

Shine, H. J. (Turner, E. E.), Synthesis of 2,3,5-Trimethylhexane and 2,4,6-Trimethylheptane, J. Inst. Petr. 36, 70-3, Feb., 1950.

Shis, C. C. (Komarewsky, V. I.), Polymerization of Isoprene, J. Am. Chem. Soc. 72, 1562-3, April, 1950.

Shivers, Allan, Problems Relating to Conservation in the Member States, IOCC, Summer Meeting, French Lick Springs Hotel, French Lick, Ind., Aug. 3-5, 1950.

Shock, D. A. (Hackerman, N.), Corrosion in Sulfur Production—The Use of an Alloy Protective Coating, NACE, 1950 Conference and Exhibition, Hotel Jefferson, St. Louis, Mo., April 4-7, 1950.

Shock, D. A. (Sudbury, J. D.), Corrosion Environments and Methods of Mitigation in Producing Sour Crude, API, Spring Meeting, Rocky Mountain District, Division of Production, Gladstone Hotel, Casper, Wyo., April 13-14, 1950.

Shoemaker, F. G., Fundamental Advantages of Diesel Engines for Trucks, SAE, National West Coast Meeting, Biltmore Hotel, Los Angeles, Calif., Aug. 14-16, 1950.

Short, G. H. (Crouch, W. W. and Shulze, W. A.), Sulfur Compounds from Petroleum Hydrocarbons. Reactions and Derivatives of Tertiary Aliphatic Mercaptans, ACS, 5th Regional Meeting, Symposium on Chemicals from Petroleum, Oklahoma City, Okla., Dec. 10, 1949.

Shrock, Robert R., Some Physical Aspects of Ancient Reef Complexes, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Shuler, Ellis, (Bailey, C. R., Bilhartz, H. L., and Dunlap, H. F.), Relation Between Electrical Resistivity and Brine Saturation in Rocks, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Shull, E. R. (Axford, D. W. E. and Rank, D. H.), Raman Spectrum of Liquid Ethylene and Methane, J. Chem. Phys. 18, 116-7, Jan., 1950.

Simanouti, T. (Kuratani, K., Mizushima, S., and Morino, Y.), Infrared and Raman Spectra of Hexachloroethane, J. Chem. Phys. 17, 838-9, Sept., 1949.

Simanouti, T. (Mizushima, S.), Raman Spectra of Solid N-Paraffins, J. Chem. Phys. 17, 1102-6, Nov., 1949.

Simanouti, Takehito, (Mizushima, San-Ichiro), Raman Frequencies of n-Paraffin Molecules, J. Am. Chem. Soc. 71, 1320-24, April, 1949.

Simon, William, The Legality Under the Patman Act of the Good-Faith Competition Which is Required by the Sherman Act, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Simons, H. P. (Dotson, J. M., Holden, J. H., Seibert, C. B., and Schmidt, L. D.), New Method Measures the Solid: Gas Ratio in High-Solid Flow, Chem. Eng. 56, 129-30, Oct., 1949.

Simpson, D. M. (Sutherland, G. B. B. M.), Vibration Spectra of Hydrocarbon Molecules. II. Skeletal Frequencies in Certain Branched Paraffins, Proc. Roy. Soc. 199, 169-83, Oct. 25, 1949.

Simpson, J. B. (Fruechtenicht, H. L.), Underground Storage of Gas, Oil & Gas J. 48, 70-2, 76-7, June 2, 1949.

Simpson, N. H., Causes of Corrosion in Airplanes and Methods of Prevention, NACE, South Central Regional Meeting, Adolphus Hotel, Dallas, Tex., Oct. 3-4, 1949.

Sims, W. P. (Frailing W. G.), Lakeview Pool, Midway-Sunset Field, AIME, Petroleum Branch Fall Meeting, Elks Club, Los Angeles, Calif., Oct. 20-21, 1949.

Sipos, F. (McPherson, G. R.), The Effect of Natural Gasoline on Motor Quality, Oil and Gas J. 48, 72-5, 92, Nov. 3, 1949.

Sliepsevich, C. M. (Brown, G. G.), Catalytic Reactions at High Pressures and Temperatures, AIChE, Boston Regional Meeting, New Ocean House, Swampscott, Mass., May 28-31, 1950.

Slobod, R. L., Attainment of Connate Water in Long Cores by Dynamic Displacement, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Sloss, L. L. (Dapples, E. C. and Krumbein, W. C.), Paleogeographic Distribution and Classification of Reefs, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Small, N. J. H. (Ubbelohde, A. R.), Crossed Reaction Chains in Oxidation by Molecular Oxygen. Part I. Oxidation of Hydrocarbons in Aldehyde—Air Mixtures, J. Chem. Soc., 723-8, Feb., 1950.

Smith, F. (Musgrave, W. K. R.), Fluorination of Hydrocarbons, J. Chem. Soc. 3021-6, Nov., 1949.

Smith, F. A. (Creitz, E. C.), Infrared Spectra of Liquid Butenes, J. Research Natl. Bur Standards 43, 365-7, Oct., 1949.

Smith, H. A. (Bedoit, W. C., Jr. and Fuzek, J. F.), Raney Nickel Catalysts, J. Am. Chem. Soc. 71, 3769-71, Nov., 1949.

Smith, H. A. (Fuzek, J. F. and Meriwether, H. T.), Catalytic Hydrogenation of Terpenes, J. Am. Chem. Soc. 71, 3765-9, Nov., 1949.

Smith, J. C. (Huffman, H. M., Scott, D. W., and Waddington, Guy), Heat Capacities of 3 Hexanes, J. Am. Chem. Soc. 71, 3902-6, Dec., 1949.

Smith, J. M. (Hall, R. E.), Design of Gas-Solid Catalytic Reactors, Chem. Eng. Progress 45, 459-70, July, 1949.

Smith, J. M. (Fisher, R. A.), Kinetics of Reaction Between Methane and Sulfur Vaport, ACS, 117th Meeting, Div. of Industrial and Engineering Chemistry, Houston, Tex., March 26-30, 1950.

Smith, J. R. (Ball, J. S. and Dinneen, G. U.), Olefins in Naphthas, Petr. Refiner 29, 129-34, May, 1950.

Smith, J. R. (Ball, John S., Dinneen, G. U. and Thompson, C. J.), Adsorption Analysis by Displacement Techniques, ACS, 116th Meeting, Atlantic City, N. J., Sept. 18-23, 1949.

Smith, R. D., Construction, Maintenance and Repair, IAA, 50th Annual Convention, Fairmont Hotel, San Francisco, Calif., March 27-29, 1950.

Smith, R. V., Determination of Friction Factors for Measuring Productivity of Gas Wells, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Smith, S. S. (Curry, W. J. and Rush, E. H.), Internal and External Corrosion Experience in Shell's Products Pipe Lines, NACE, 1950 Conference and Exhibition, Hotel Jefferson, St. Louis, Mo., April 4-7, 1950.

Smith, W. R. (Beebe, R. A., Kington, G. L. and Polley, M. H.), Heats of Adsorption of Pentanes of Carbon Black, J. Am. Chem. Soc. 72, 40-2, Jan. 1950.

Snyder, A. D. (Davis, D. S.), Ultimate Yield Nomograph for Recycle Processes, Petr. Refiner 29, 134, Jan., 1950.

Solliday, A. L., When Do We Need a Synthetic Fuel Industry, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Souders, Mott, Jr. (Hurd, C. O. and Matthews, C. S.), Entropy and Heat of Formation of Hydrocarbon Vapors, Ind. Eng. Chem. 41, 1048-56, May, 1949.

Souders, Mott, Jr. (Hurd, C. O. and Matthews, C. S.), Thermodynamic Properties and Molecular Structure, Ind. Eng. Chem. 41, 1037-48, May, 1949.

Spain, H. H. (Buchan, R. C., Sullivan, R. J. and Williams, Milton), Dehydration of Natural Gas, API, Spring Meeting, Southwestern District, Division of Production, Adolphus Hotel, Dallas, Tex., March 8-10, 1950.

Spalding, D. B., Combustion of Liquid Fuels, Nature 165, 160, Jan. 28, 1950.

Spalding, S. C., Jr. (Stevens, P. G.), New Synthesis of the Cyclopentane Ring, J. Am. Chem. Soc. 71, 1687-91, May, 1949.

Spangler, C. V., Solid Adsorbents for Storage of Natural Gas, Oil and Gas J. 47, 94-9, May 5, 1949.

Speller, F. N. (LaQue, F. L.), Water-Side Deterioration of Diesel Engine Cylinder Liners, NACE, 1950 Conference and Exhibition, Hotel Jefferson, St. Louis, Mo., April 4-7, 1950.

Spencer, R. K. (Kaye, H.), Acid Sludge Fuels, Oil and Gas J. 48, 80-1, Feb. 9, 1950.

Spencer, R. S. (Poffenberger, Nolan), Equilibrium State of Catalyst in Moving Bed Reactor Systems, AIChE, Boston Regional Meeting, New Ocean House, Swampscott, Mass., May 28-31, 1950.

Sperling, R., Reactions of Cyclic Hydrocarbons. I., II., and III., J. Chem. Soc., 1925-7, 1928-32, 1932-8, July, 1949.

Spurlock, E. M., An Effective Accident Investigation Procedure, SGA, 42nd Annual Convention, Galveston, Tex., March 27-29, 1950.

Stach, Leo W. (Uwatoko, K.), Geological Control of Methane Gas Accumulation in Japan, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Stach, L. W., Oil Producing Industry in Japan, The Petr. Engr. 22, B-35-40, June, 1950.

Stahly, E. E. (Corson, B. B., Jones, H. E., Hinckley, J. A., and Welling, C. E.), Butadiene from Ethyl Alcohol, Ind. Eng. Chem. 42, 359-75, Feb., 1950.

Stair, Ralph, Spectra of Substituted Benzenes, J. Research Natl. Bur. Standards 42, 587-93, June, 1949.

Stamm, A. F. (Lamb, E. P.), A Method of Predicting Road Performance of Commercial Vehicles, SAE, Annual Meeting, Book-Cadillac Hotel, Detroit, Mich., Jan, 9-13, 1950.

Stanfield, K. E. (Frost, I. C.), Estimating Oil Yield of Oil Shale, Anal. Chem. 22, 491-2, March, 1950.

Staples, G. A., Winter Supply Problems of Producers and Gatherers, INGAA, Annual Meeting, Dallas, Tex., Oct. 31, 1949.

Staples, Ray, Some Aspects of Core Analysis as They Apply to Secondary Recovery, North Texas Oil and Gas Association, 20th Annual Meeting, Kemp Hotel, Wichita Falls, Tex., March 25, 1950.

Steacie, E. W. R. (Trotman-Dickenson, A. F.), The Reactions of Methyl Radicals With Hydrocarbons, J. Am. Chem. Soc. 72, 2310-11, May, 1950.

Stecker, Glen (Hickey, John and Thomas, C. L.), Chemistry of Clay Cracking Catalysts, Ind. Eng. Chem. 42, 866-71, May, 1950.

Steffens, L. R. (Albright, R. E., Apjohn, T. L. and Holaday, William M.), Fuels—Their Present and Future Utilization, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Stenzel, Henryk B., Cycles, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Stepanoff, A. J., Volute vs Diffusion Casing for Centrifugal Pumps, Sixth Annual National Conference on Industrial Hydraulics, Sherman Hotel, Chicago, Ill., Oct. 18 and 19, 1950.

Sterba, M. J. (Olsen, C. R.), Effect of Reactor Temperature on Products of Fluid Catalytic Cracking, Chem. Eng. Progress 45, 692-700, Nov., 1949.

Sterba, M. J., Sulfur Content of Catalytically Cracked Gasolines, Ind. Eng. Chem. 41, 2680-87, Dec., 1949.

Sterk, B. J. (Wilkinson, E. Paul), New Data on Use of Solid Dessicants, AGA, Natural Gas Spring Meeting, Hotel Mayo, Tulsa, Okla., May 8-9, 1950.

Stevens, C. E., Jr., BI-Metallic Pistons, SAE, National West Coast Meeting, Biltmore Hotel, Los Angeles, Calif., Aug. 14-16, 1950.

Stevens, P. G. (Spalding, S. C., Jr.), New Synthesis of the Cyclopentane, Ring, J. Am. Chem. Soc. 71, 1687-91, May, 1949.

Stevenson, D. P. (Beeck, O., Otvos, J. W., and Wagner, C. D.), Hydrogen Exchange Reactions of Paraffins on Isomerization Catalyst, J. Chem. Phys. 17, 419-20, April, 1949.

Stewart, L. D. (Nelson, W. L.), Effect of Oil on Plastic Properties of Petroleum Waxes. Development of Plasticity Tests, Ind. Eng. Chem. 41, 2231-8, Oct., 1949.

Stewart, R. H., Radiography—A Refinery Corrosion Inspection Tool, Petr. Processing 4, 1211-14, Nov., 1949.

Stewart, T. D. (Calkins, W. H.), Hydrogen Transfer Reaction of Butylenes in Sulfuric Acid, J. Am. Chem. Soc. 71, 4144-5, Dec., 1949.

Stewart, W. H., Cures for Corrosion in Gas-Condensate Wells, NGAA, 29th Annual Convention, Texas Hotel, Fort Worth, Tex., April 24-26, 1950.

Stigger, E. K. (Nichols, J. H. and Williams, G. C.), Plate Efficiencies in Fractionating Columns, Chem. Eng. Progress 46, 7-16, Jan., 1950.

Stiles, W. E. (Todd, Robert), Diamond Bit Coring, AIME, Annual Joint Meeting of the Texas Sections, A & M College of Texas, College Station, Tex., Dec. 8-9, 1949.

Stillbroer, C. (Broeze, J. J.), Diesel Combustion Problems, SAE J. 57, 64-5, March, 1949.

Stone, Bert L., Development of Blowout Prevention and Controls, API, Spring Meeting, Pacific Coast District, Division of Production, Biltmore Hotel, Los Angeles, Calif., May 11-12, 1950.

Storch, H. H. (Friedman, Sam, Pelipetz, M. G., and Weller, Sol), Coal Hydrogenation Catalysts, Ind. Eng. Chem. 42, 330-4, Feb., 1950.

Stover, Jerry (Paine, C. J.), Rig to Office Communications, AAODC, 9th Annual Meeting, Baker Hotel, Dallas, Tex., Sept. 19-21, 1949.

Stragand, G. L. (Safford, H. W.), Microanalysis of Sulfur in Organic Compounds, Anal. Chem. 21, 625-8, May, 1949.

Strehlau, D. R. (Ipatieff, V. N. and Pines, Herman), Hydrogen Transfer. III. Reaction of p-Ethyltoluene and p-Propyltoulene With Methylcyclohexene. Synthesis of Diarylakanes, J. Am. Chem. Soc. 71, 3534-9, Oct., 1949.

Strehlau, D. R. (Ipatieff, V. N. and Pines, Herman), Hydrogen Transfer, J. Am. Chem. Soc. 72, 1563-8, April, 1950.

Streiff, A. J. (Mair, B. J. and Rossini, F. D.), Purification of Five Hydrocarbons by Adsorption, Ind. Eng. Chem. 41, 2037-8, Sept., 1949.

Stubbs, F. J. (Hinshelwood, Cyril N. and Partington, R. G.), Thermal Decomposition of n-Pentane, J. Chem. Soc. 2674-9, Oct., 1949.

Stubbs, F. J. (Hinshelwood, Cyril), Thermal Decomposition of Paraffin Hydrocarbons, Proc. Roy. Soc. 200, Series A. 1063, 458-73, Feb. 22, 1950.

Sudbury, J. D. (Shock, D. A.), Corrosion Environments and Methods of Mitigation in Producing Sour Crude, API, Spring Meeting, Rocky Mountain District, Division of Production, Gladstone Hotel, Casper, Wyo., April 13-14, 1950.

Sullivan, E. J., Synopsis of the United States Supreme Court Decision in The Tidelands Case, Oil and Gas Law Institute, Rainbow Hotel, Great Falls, Mont., June 24-25, 1949.

Sullivan, R. J. (Buchan, R. C., Spain, H. H., and Williams, Milton), Dehydration of Natural Gas, API, Spring Meeting, Southwestern District, Division of Production, Adolphus Hotel, Dallas, Tex., March 8-10, 1950.

Sunderland, Thomas E., Save The Sherman Act From Its Friends, Dallas Bar Association, Dallas, Tex., March 25, 1950.

Sutherland, G. B. B. M. (Simpson, D. M.), Vibration Spectra of Hydrocarbon Molecules. II. Skeletal Frequencies in Certain Branched Paraffins, Proc. Roy. Soc. 199, 169-83, Oct. 25, 1949.

Swann, David H., Possible Future Oil Provinces of North America—Illinois Basin, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Swartz, G. B., Jr. (Offutt, W. C. and Taylor, J. E.), Fuels for High Compression Engines. A Preliminary Study of the Selective Blending of Gasoline Distillates from Present-Day Refining Processes, Ind. Eng. Chem. 41, 2359-65, Oct., 1949.

Sweeney, Albert E., Jr., Secondary Recovery and Stripper Well Reserves of the United States, North Texas Oil and Gas Association, 20th Annual Meeting, Kemp Hotel, Wichita Falls, Tex., March 25, 1950.

Sweeney, M. P. (Gilliland, E. R. and Lewis, W. K.), The Gassification of Carbon With Metal Oxides in a Fluidized Powder Bed, AIChE, Boston Regional Meeting, New Ocean House, Swampscott, Mass., May 28-31, 1950.

LAUGH with BARNEY

Old Jess, a weather-beaten guide, and his tenderfoot companion were camping out in rattlesnake country. The tenderfoot spoke:

"Jess, is there any other cure for snake-bite besides whiskey?"

Jess looked up with a grin and drawled: "Who cares, son, who cares?"

The prizefighter wasn't having spectacular luck in fending off his opponent's attack. In fact, he looked pretty sick of the whole affair.

"Stop those punches!" shouted his excited manager from the corner.

The fighter managed to move his battered lips enough to retort: "You don't see any of 'em gettin' past me, do you?"

A Texas frontier man came into a camp, riding an old mule.

"How much for the mule?" asked a bystander.

"Jist a hundred dollars," answered the rider.

"I'll give you five dollars," said the other.

The rider stopped short as if in amazement, and then slowly dismounted. "Stranger," he said, "I ain't goin' to let ninety-five dollars stand between me and a mule trade. The mule's yourn."

A young theologian named Fiddle,
Refused to accept his degree,
For said he, it's enough to be
Fiddle without being Fiddle D. D.

A drunken man staggered up to a hotel desk late one night and demanded another room.

"But you have the best room in the house, sir," answered the clerk.

"I don't care," was the stubborn answer, "I want another room, and I want it quick."

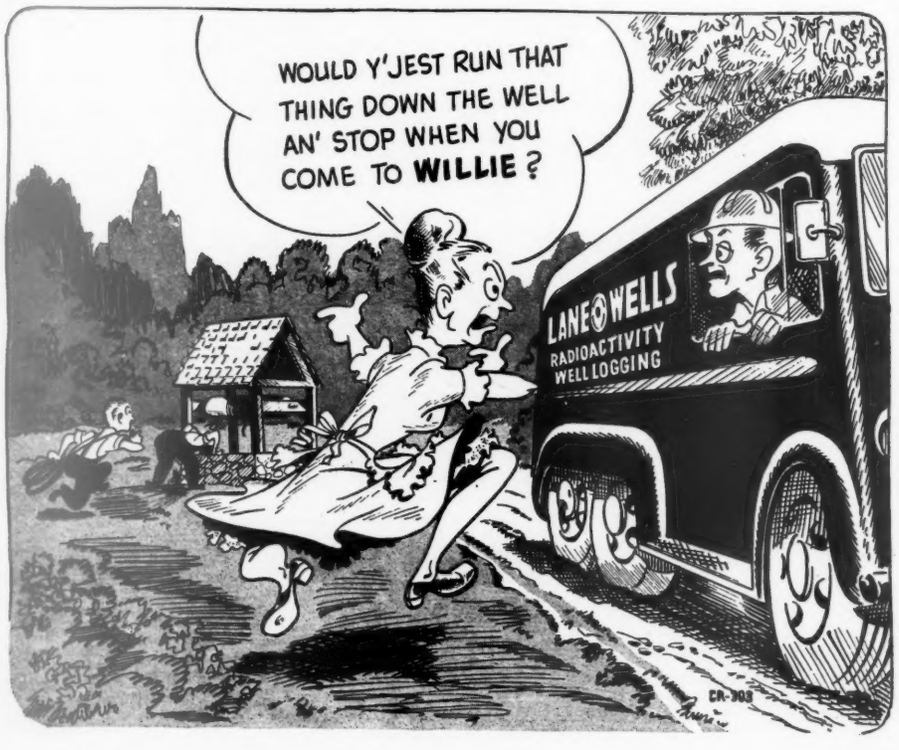
Realizing that it would do no good to argue or reason with him any further, the clerk turned to the bellboy and said: "Move this gentleman out of 505 and put him in 508, right away."

Completely satisfied, the inebriated guest moved toward the elevator, offering no word of explanation or thanks.

"Just a minute," said the clerk.

"Would you mind telling me, sir, why don't you like room 505?" not expecting a sensible answer. However, he got one.

"The damn thing's on fire."



Sandy had been courting Maggie for something like two years, but had never brought himself to a downright proposal, and one evening when the two were sitting in silence, Maggie murmured:

"A penny for your thoughts, Sandy."

"Weel," said Sandy, with surprising boldness, "tae tell ye the truth, I was jist thinkin' how fine it wad be if ye were to gie me a wee bit of a kiss."

"I've naw objection," simpered Maggie, moving over and kissing Sandy on the tip of his ear. Then she moved back.

Sandy relapsed into a brown study once more, and the clock ticked off several minutes.

"An' noo what are ye thinkin' aboot, eh?" resumed Maggie. "Anither kiss, maybe?"

"Naw, Maggie; it's mair serious noo."

"Is it, Sandy?" asked Maggie, softly, her heart beating rapidly with anticipation.

"An' what might it be?"

"I was just thinkin'," answered Sandy, "that it was about time ye were payin' me that penny."

"Papa," questioned the son, "what is the person called who brings you in contact with the spirit world?"

"A bartender, my son," was the spirited reply.

First Old Maid: Men are all alike.
Second Old Maid: Yes, men are all I like, too.

A little old lady entered the post office with a package containing a Bible. The postal attendant looked over the tightly wrapped parcel, shook it, and asked, "Is there anything breakable in this?"

"Nothing but the Ten Commandments," was the reply.

New employee: Do you give your clerks two weeks' vacation?

Boss: No, they get a month; two weeks when I go on my vacation, and two weeks when they go on theirs."

Doting Mother: And what did mama's little darling learn at school today?

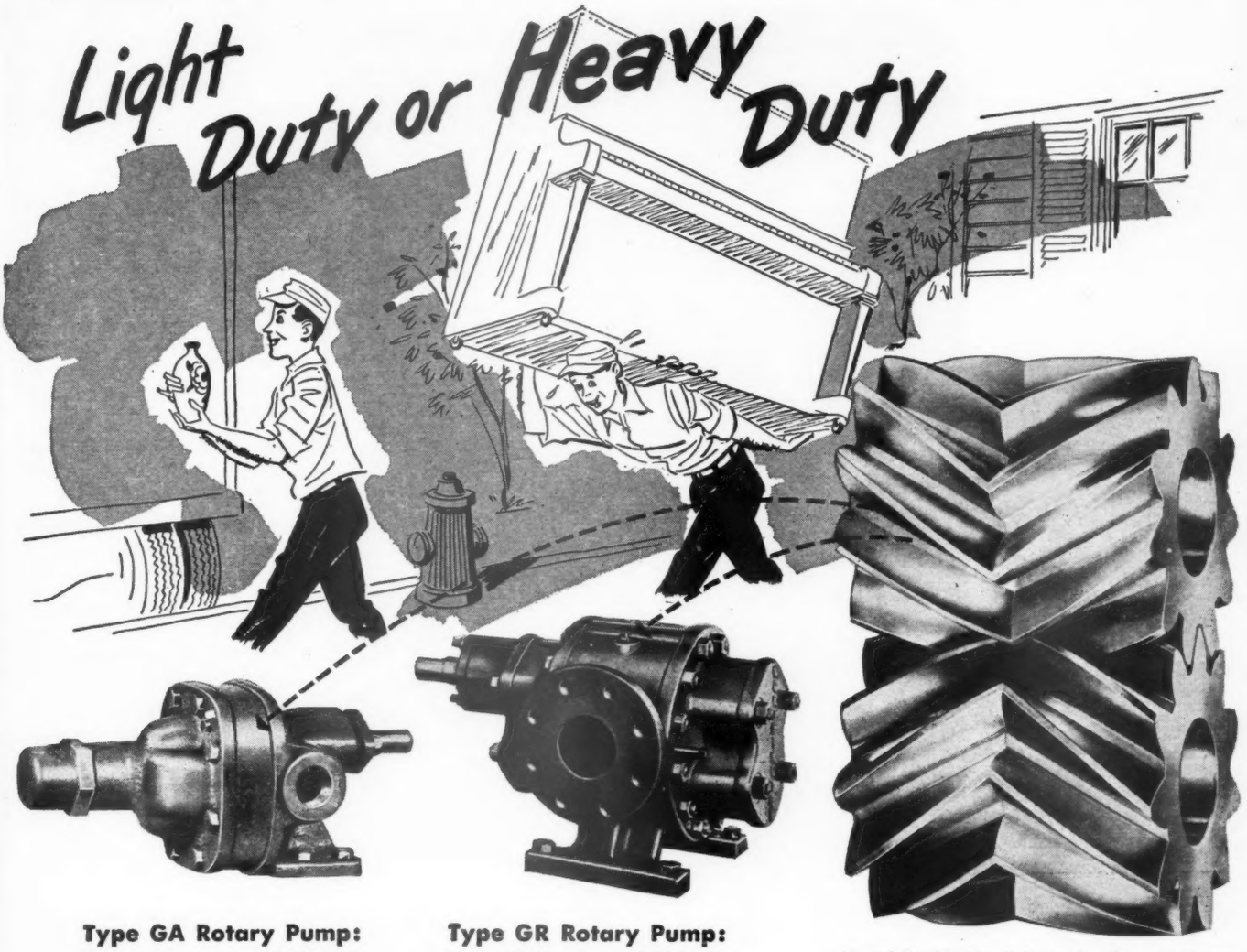
Sonny: I learned two punks not to call me mama's little darling.

The golfer had lost his ball, and, not unnaturally, was inclined to be annoyed with his caddie.

"Why the deuce didn't you watch where it went?" he asked angrily.

"Well sir," said the boy, "It don't usually go anywhere, and so it took me unprepared like."

Light Duty or Heavy Duty



Type GA Rotary Pump: Up to 50 gpm and 100 psi.

Type GR Rotary Pump: Up to 5000 gpm and 500 psi.

Double Helical Herringbone Gear Rotors: Quiet and efficient; extra large wearing surfaces; no axial thrust; no trapping of liquid.

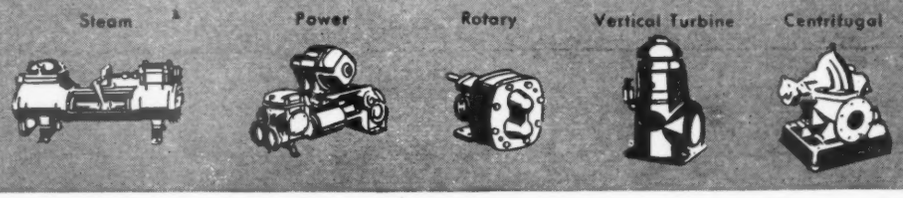
. . . You Get The Same Sturdy Construction!

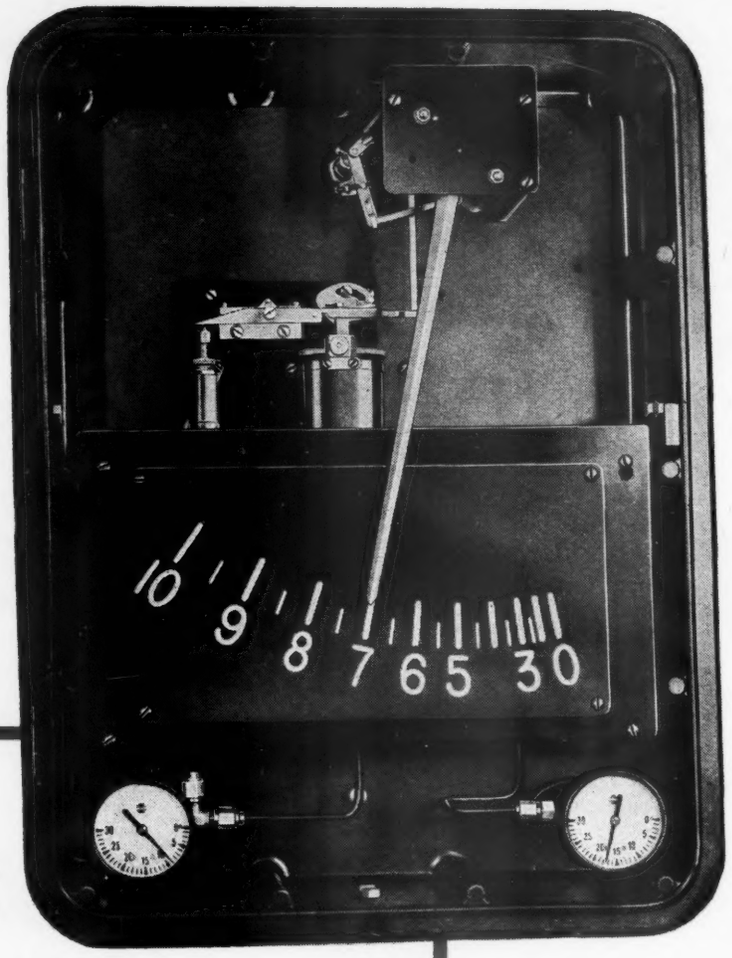
For light duty pumping of hot or cold, thin or viscous liquids, use the Type GA . . . for heavy duty, hook up its big brother, the Type GR. Either way you're sure of the ruggedest construction and smoothest performance it's possible to build into a rotary pump. That's because both these hard working huskies incorporate the special herringbone rotors that operate so quietly and efficiently . . . combining with the whole advanced Worthington design for long, trouble-free, money-saving service. Get the whole story that proves *there's more worth in Worthington.* Write, describing your requirements to *Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, New Jersey.*

WORTHINGTON

P-0-2

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB





1. **NO NEED TO BREAK TUBING CONNECTION** for nozzle adjustment.

2. **INSTRUMENT CAN BE REVERSED** by shifting one link without disturbing other adjustments.

3. **LINKAGE ALIGNMENT MADE EASY IN FIELD** with positioning device.

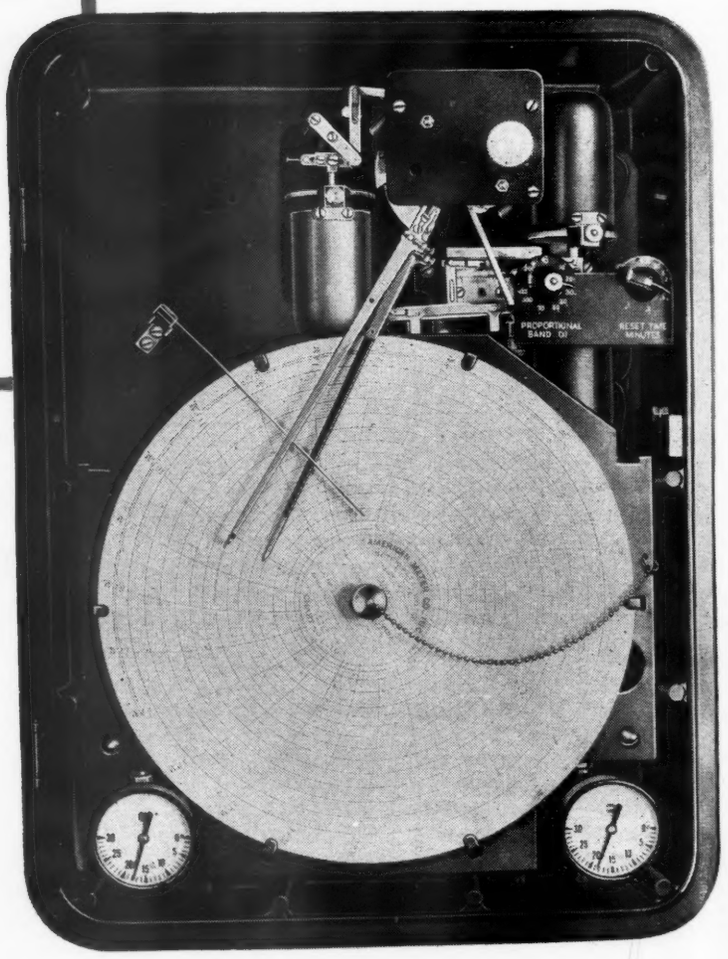
4. **MAXIMUM PROPORTIONAL BAND CHANGES** with minimum output pressure changes.

5. **EASY POSITIONING OF NOZZLE** permits widening of proportional band without disconnecting tubing.

6. **DAMPING DEVICE IN RELAY** insures smooth operation. Primary orifice in relay is self-cleaning.

SERIES A-88

PNEUMATIC TRANSMITTER AND CONTROLLER



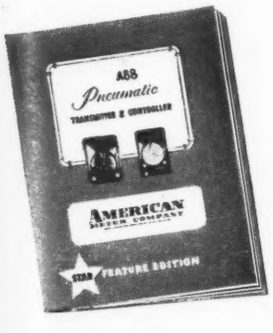
The eight outstanding features of the new American Meter Company Series A-88 pneumatic Transmitter and Controller point to just one all-important accomplishment—the solution to numerous servicing and maintenance problems in the control of flow, pressure, liquid level and specific gravity.

7. RESET VALVE IS SPRING-CLOSING and sealed with bellows. It is calibrated according to time.

8. LINEARITY ADJUSTMENT between transmitter and receiver.

ADDITIONAL POINTS DESCRIBED IN BULLETIN CT-49. The eight servicing and maintenance points listed cover only a few of the features technically described in the Bulletin pictured below.

It will be of interest to Instrument men who wish to keep in touch with the latest developments in instruments control. Write for a copy.



AMERICAN METER COMPANY

INCORPORATED ESTABLISHED 1836

Albany • Alhambra • Atlanta • Baltimore • Birmingham • Boston • Chicago • Dallas
Denver • Erie • Fort Lauderdale • Houston • Joliet • Kansas City • Los Angeles • Minneapolis
Odessa • Philadelphia • Pittsburgh • San Francisco • Tulsa
In Canada—Canadian Meter Co., Ltd., Hamilton, Ont.

OIL AND GAS TRADE NEWS

PEPA Holds 22nd Annual Convention in Arkansas

The 22nd anniversary of the Petroleum Electric Power Association was observed at the Association's annual convention scheduled at Hot Springs, Arkansas, last month according to L. V. Dugas, of Beaumont, Texas, association president. Besides President Dugas, other association officers are R. E. Patrick, Kansas Gas and Electric Company, Wichita, Kansas, vice president, and T. E. Graham, Oklahoma Gas and Electric Company, secretary-treasurer. O. C. Bailey, of El Dorado, Arkansas, chairman of the Arkansas Oil and Gas Commission, delivered the address of welcome to the convention delegates.

Speakers who presented papers during the first day included Joe Carle, Reda Pump Company, Bartlesville, Oklahoma; W. L. Pearson, power engineer, Southwestern Public Service Company, Lubbock, Texas; Mitchell Tucker, advertising manager, The Oil and Gas Journal, Tulsa, Oklahoma; C. W. Chachere, electrical engineer, Gulf Refining Company, Shreveport, Louisiana; William A. Derr, supervising engineer, gear division, Western Electric Corporation, East Pittsburgh, Pennsylvania. Charles T. Evans, executive secretary, Arkansas Utilities Association, Little Rock, was the principal speaker at the annual banquet.

Speakers were W. M. Shepherd, vice president, Arkansas Power and Light Company, Little Rock; W. M. Carney, general superintendent, Lion Oil Company, El Dorado, Arkansas; Peter Grandone, petroleum engineer, Bureau of Mines, Petroleum Experiment Station, Bartlesville, Oklahoma, and Ted Workman, president, Ted Workman Advertising Company, Dallas, Texas.

Kansas Agent Named

Buckeye Supply Company, Zanesville, Ohio, has been appointed to succeed Gross Supply Company, El Dorado, Kansas, as distributor for Bucyrus-Erie Company, South Milwaukee, Wisconsin. Its territory includes the entire state of Kansas except for the counties of Stanton, Grant, Haskell, Gray, Meade, Seward, Stevens, Morton, Linn, Bourbon, Crawford, Cherokee, and Labette. Known as the Zanesville Tool and Supply Company for many years, Buckeye Supply adopted its new name as of August 1, 1950. It purchased the Gross business at the same time. In Kansas, Buckeye Supply will operate from the former Gross office at 615 South Main, El Dorado, and from a new store opened recently at Chase, Kansas. J. M. Loban has been named district manager. He will be assisted by Clyde O. Jones and Dick Sproul at El Dorado and by Jerry Patton and Clinton Smith at Chase.

Granite Is Distributor

The Cleco division of the Reed Roller Bit Company, Houston, Texas has announced the appointment of Granite City Tool Company, St. Cloud, Minnesota as distributors of Cleco products in that area. In addition to handling the full line of Cleco pneumatic tools, the Granite Company will maintain complete stocks of Cleco parts and accessories. Pneumatic tools include those for construction, manufacturing, metal fabrication, etc.

Ethyl to Build New California Offices

Ethyl Corporation is erecting a new two-story office building in Los Angeles, California to house its western region offices, the company has announced. The new structure, scheduled to be ready for occupancy next spring, will be at the corner of Miramar Street and Huntley Drive. Ethyl's western region is currently occupying space in the Continental Building at 408 South Spring Street in Los Angeles. The new building, which will contain over 9400 sq ft, will include office space, an auditorium, conference room, and food serving facilities. An enclosed parking space will be provided at the rear of the building.

Hill, Hubbell Manager Confers With President

The Hill, Hubbell and Company manager, M. M. Bowen, who recently returned from the American Gas Association 32nd annual convention in Atlantic City, New Jersey, is currently host for his corporation's president, H. L. Jones, General Paint Corporation. Jones has climaxed a tour of all major General Paint factories and plants with a conference with Bowen at the Hill, Hubbell pipe-wrapping plant in Cleveland, Ohio. Activities of 1950 and preliminary 1951 plans are under discussion.

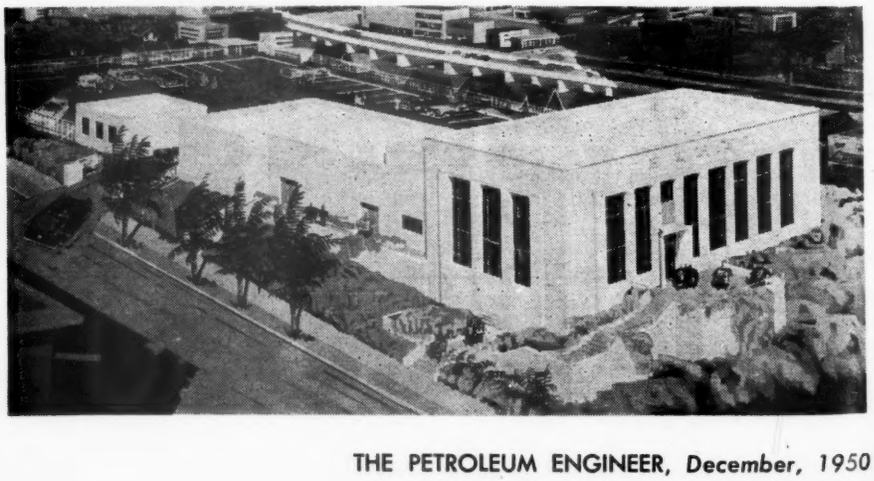
Stoody Distributor's List

Stoody Company, Whittier, California, has issued a corrected list of its distributors. In California, distributors are: Agricultural Supply Company, Hust Brothers, Inc., Moore's Welding Supply Company, C. S. Parsons Company, California Welding Supply Company, Hickinbotham Brothers, Ltd.

General Auto Supply Company, Inc., is the only distributor in Florida.

Others are: Illinois, J. C. Menzies and Company; Louisiana, Welders Equipment Company, Welders Supply Company; Maine, J. J. Boulter and Son, Northeastern Supply Company, Lewiston Welding Company, Portland Welding Supply; Nebraska, Harrington Welding Company; New Mexico, Bowen Welding Supply; Oregon, Eugene Welders Supply Company, Industrial Air Products Company; Pennsylvania, Welding Materials, Inc.; Texas, Taylor-Simpkins, Inc., Gulf Welding Supply Company, C. F. Myrow Supply Company; Washington, Western Oxygen, Inc.

Ethyl's new two-story office building in Los Angeles, California. It is the new home of the company's western region offices.



Warner Is Sales Manager

Paul E. Warner has been named district sales manager for the Philadelphia, Pennsylvania area for The Ohio Injector Company of Wadsworth, Ohio. He succeeds John C. Rufe, who has retired after 10 years in the Philadelphia post. Ruf is a past president of the American Supply and Machinery Manufacturers' Association, Inc.

J. C. Rufe

Baker Opens New Warehouse

Baker Oil Tools, Inc. has announced the opening of a new district warehouse in the Mountain View addition of Casper, Wyoming. E. M. (Slim) Davies will be warehouse manager, and Sam D. Chilcote will cover the territory as Baker sales and service engineer. The new facilities and increased personnel will make the complete line of Baker products and services available to Rocky Mountain operators, according to a statement made by J. E. Meador, district manager.

General American to Open Chicago Tank Terminal

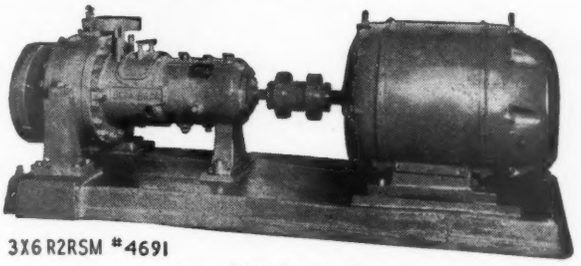
General American Transportation Corporation announces the opening of a fifth public tank storage terminal for storage of chemical and petroleum products. Strategically situated to service the entire Midwest, the new Chicago terminal offers various size tankage with loading and unloading facilities. Centrally situated in the heart of Chicago's clearing industrial district, at 67th and Archer on the Sanitary and Ship Canal, the new terminal is serviced by all of the many railroads that come into Chicago.

Altens Opens Texas Store

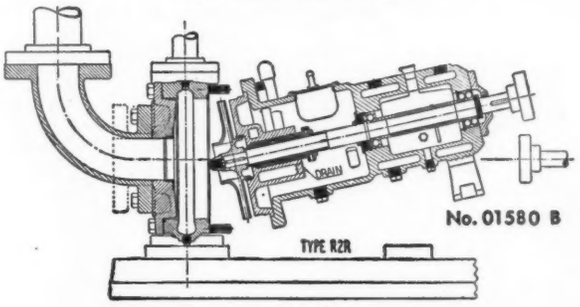
Altens Foundry and Machine Works has opened a new and complete warehouse at 206 Michigan Street in Wichita Falls, Texas. This Wichita Falls branch will enable supply stores throughout the Southwest to obtain immediate delivery on Alten equipment and eliminate transit delay on items produced in the company's Ohio plants. Warren M. Benson, vice president of Altens who made the announcement, reports that the warehouse is already fully stocked, and is offering 24 hour service to supply stores in the area. Ted Michie has been named warehouse manager.

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

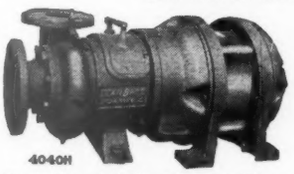
DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE; Type R2R, Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.

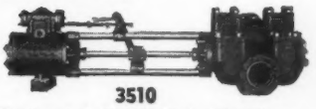
Capacities: 50 to 2000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL and RECIPROCATING PUMPS

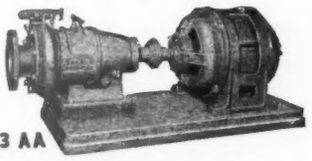


Close Coupled Centrifugal Pump

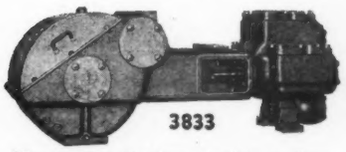


3510

Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids

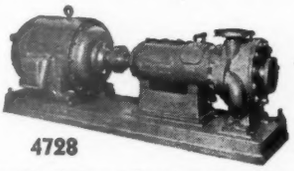


Pedestal Mounted Centrifugal Pump



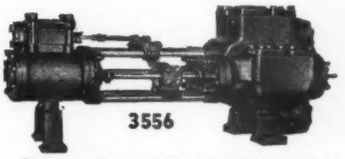
3833

Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



4728

Double Pedestal Bearing Centrifugal Pump



3556

Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST.

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

In all the World there's only one TUBE-TURN Welding Fitting as shown by this trade mark... the right mark for every need in welding fittings and flanges.

tt TUBE-TURN TRADE MARK

More than ever, the services of your TUBE TURNS' Distributor can be important to the smooth operation of your business.

TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY DISTRIBUTORS IN ALL PRINCIPAL CITIES

DISTRICT OFFICES: NEW YORK • PHILADELPHIA • PITTSBURGH • CHICAGO • HOUSTON • TULSA • SAN FRANCISCO • LOS ANGELES

Corrosion Testing Station Holds Formal Opening

Representatives of more than 100 industrial companies and government officials attended the formal opening of the Harbor Island addition to the Kure Beach corrosion testing project near Wilmington, North Carolina. The project is under the direction of The International Nickel Company, Inc. Paul D. Merica, executive vice president of International Nickel, presided. With the new laboratory and marine exposure racks added to the Harbor Island, the Kure Beach project has increased facilities for the study of over 20,000 specimens of all types of materials in sea water and sea air. Among them are specimens of metals, alloys, non-metallic materials, and protective coatings—including paint—and even rope.

New Tuboscope Offices

The new building at 2400 Holmes Road, Houston, Texas, is part of the continuing expansion program of

Tuboscope Company. Serving as Gulf Coast division headquarters for the company, the building also contains an instrument repair shop and warehouse facilities. Laboratory and repair shops situated here are used in the maintenance of the Sonoscope and other specialized inspection devices used by Tuboscope Company. The Gulf Coast operations are under the supervision of B. H. (Tennessee) Pickard who is a vice president of the company. Tuboscope Company is a division of Tubular Service and Engineering Company.

GM Packages Win Prizes

At the fourth annual protective packaging and materials handling competition conducted by the Society of Industrial Packaging and Materials Handling Engineers at Philadelphia, Pennsylvania recently, Detroit Diesel Engine Division of General Motors took two first prizes in the six packaging classifications and "honorable mention" for the second best inner pack in the show. C. L. Foy, in charge of package design at Detroit Diesel, submitted three entries in the competition. The two winning entries were a fuel injector package and cylinder kit package, scientifically tested cartons for precision-built, carefully finished vital engine parts.

Marsteller Resigns As Rockwell Vice President

William A. Marsteller has resigned as vice president of the Rockwell Manufacturing Company of Pittsburgh and as vice president and director of Edward Valves, Inc., East Chicago, Indiana, to establish The Marsteller Company, consultants in marketing and advertising. The new firm will be situated at 612 N. Michigan Avenue, Chicago, after the first of the year. Marsteller has been responsible for advertising, market research and sales promotion for the Rockwell Manufacturing Company and its 14 divisions. Recently in an executive advisory capacity with Edward Valves, he was formerly in charge of sales, advertising and employee relations for this company.

W. A. Marsteller

Bechtel Aids Students

Five scholarships for the academic year 1950-1951, three for students at the University of California and two for Stanford University students, have been established by the board of directors of Bechtel Corporation. Stephen D. Bechtel, president, is a member of the council of the California Alumni Association. The three University of California scholarships, according to the Bechtel board's request, will be given to students in the college of engineering, preferably in the senior year. At Stanford, one scholarship will be awarded to a second year student in the graduate school of business. The other Stanford scholarship, in the school of engineering, would be given to a student specializing in civil, electrical, or mechanical engineering.

Appoints Stentz as Agent

Appointment of Stentz Equipment Company, Tulsa, Oklahoma to handle the engineering and sales of Pyrene air foam systems to the oil industry has been announced by the Pyrene Manufacturing Company, Newark, New Jersey. The Stentz organization, including branch offices in Houston and Dallas will serve throughout the states of Texas, New Mexico, Oklahoma, Kansas, Arkansas, Nebraska, Colorado, Wyoming, Montana, Missouri, South Dakota, Western North Dakota, and Western Louisiana. Pyrene air foam was developed and introduced by Pyrene Company who supplied air foam to the first fire department in 1936.

These men are working for you

Astute, efficiency-minded J. A. Henby, Vice President in charge of Production, checks on location of new equipment.

Fred Smith, deliberate, analytical Chief Metallurgist, inspects chemical composition test being run on steel tubing.

Keen-eyed, thorough Fred Brown, Chief Inspector, uses micrometer of special design to check hard-to-reach point.

John Ochs, forceful, energetic Superintendent, Fittings Forging Dept., smiles over another production record.

GOOD SERVICE right down the line is a tradition at Tube Turns, Inc. And with our production management, good service starts with a quality product—one you can always depend on . . .

That's why an officer of Tube Turns, Inc., is in full charge of production . . . why a noted metallurgist heads up a staff of laboratory technicians who make dead certain that only the finest seamless steel tubing goes into production . . . why a man who helped Tube Turns pioneer welding fittings today supervises the forging process . . . why a veteran inspector and more than 30 trained assistants make no less than 15 visual and instrumental inspections of *each fitting* . . .

These, of course, are the good, sound reasons why you can depend on Tube-Turn welding fittings and Tube Turns' service, always . . . *and all ways!*

"Be Sure You See The Double tt"

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

TRADE PERSONALS

▸ **August R. Maier,** 49, director of engineering of the Oil Well Supply Company died of a heart attack October 27, while playing golf. Maier was in high spirits after making a particularly good drive off the No. 12 tee of the Dallas Athletic Country Club Golf Course. As he left the tee, and without warning, he collapsed. He died within a few minutes without regaining consciousness. A doctor in the following foursome pronounced him dead before aid could be given.

A. R. Maier

Maier was well known in the oil field machinery and equipment business, having joined the "Oilwell" organization in 1930 at what is now the Wilson-Snyder Division plant at Braddock, Pennsylvania. In 1932 he was transferred to the headquarters office in Dallas as assistant chief engineer, the position he held until he was made chief engineer in 1936. His headquarters were then moved in 1941 to the principal plant of the company in Oil City, Pennsylvania, and in January 1948, he was appointed director of engineering and company patent officer, returning to Dallas. Born in Leonberg, Germany, Maier obtained his technical training at the University of Stuttgart from which he was graduated as mechanical engineer in 1924 and later took post graduate work in metallurgy at Purdue University. He contributed to the petroleum industry many designs of machinery and equipment for the drilling of oil and gas wells and the production and transportation of oil.

▸ **Harold K. Beck** has been appointed commercial vice president, in addition to his present post as manager of the Washington office of Worthington Pump and Machinery Corporation. A 25-year veteran of Worthington, Beck received his BS degree in civil engineering from Tufts College in 1925 and then took the Worthington training course. Originally assigned to the export division, he went to Washington the next year.

H. K. Beck

▸ **J. F. Rolette,** manager of the chemical division of Mud Products, Inc., Houston, Texas, died recently. Rolette opened the Houston office of Mud Products in March of this year. Prior to that he was office manager of the chemical division of Houston Oilfield Material Company for 13 years. He was 50 years old.

▸ **Ferguson Barnes** recently resigned as vice president and general manager, Ideco Columbus division, International Derrick and Equipment Company, Dallas, Texas. A native of Kentucky, Barnes was manager of the coal preparation department of Jeffrey Manufacturing Company before joining Ideco in 1939.

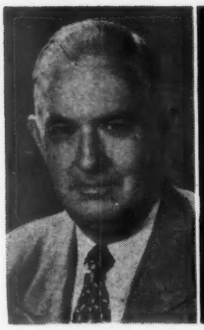
Ferguson Barnes

D. A. Carnahan

L. G. Evans

▸ **D. A. "Dave" Carnahan** was recently appointed Emsco Derrick and Equipment Company sales manager for the Pacific Coast states. He is in charge of all Emsco sales in this area excluding the D+B division. Carnahan was formerly chief engineer of the D+B division. Taking Carnahan's place as chief engineer for the entire D+B division is **L. G. "Les" Evans.** Except for time out for World War II, Evans has been with the D+B division of Emsco since 1940.

▸ **J. W. Greene** has been appointed to the newly created position of assistant manager of the valve and fitting department, Crane Company, Chicago, Illinois. Greene is particularly well qualified for this new responsibility as a result of 12 years experience in the oil fields of the southwest; 10 years in the New York and eastern industrial markets, and 5 years in the mid-west.



J. R. Gunn

J. S. Page

▸ **John R. Gunn** has been made vice president and sales manager of Page Oil Tools, Inc., Long Beach, California it was recently announced by John S. Page, president. Gunn was also appointed as a new member to the company's board of directors. Gunn formerly served as general superintendent of the machinery and outfitting division for Western Pipe and Steel on their shipbuilding program. Previous to his connection with Page he was sales representative for Alexander H. Kerr and Company, Inc., Huntington, West Virginia.

▸ Bethlehem Supply Company has announced several personnel changes throughout the company organization: **C. E. Barnard,** formerly chief clerk of the Tulsa, Oklahoma sales office, has been transferred to the Dallas sales office as office manager; **H. E. Arnold,** formerly chief clerk for the division managers, has been promoted to chief clerk of the Tulsa sales office, replacing **C. E. Barnard. P. W. Behrents,** formerly in the engineering sales department of the Tulsa general office, has been promoted and transferred to Odessa, Texas as engineering representative. **I. H. Correll,** formerly store manager at Craig, Colorado, has been transferred to Grayville, Illinois, as field representative in order to increase sales coverage in that area. **V. H. Prange,** formerly field representative at Houston, Texas, has been transferred to McAllen, Texas, and promoted to store manager. **D. G. Shank** has been transferred from Lake Charles, Louisiana, to Harvey, Louisiana, and promoted to field representative to assist in field sales in that area. **B. M. Queen,** field representative at Kermit, Texas, has been transferred to Artesia, New Mexico, in the same capacity. **J. W. Jillson** was recently employed as field representative, and will work out of the Odessa, Texas store. **L. F. Ritchie,** formerly field representative at Odessa, Texas, has been promoted to special representative. **D. R. Nicholson** at Odessa, Texas, has been promoted to manager of the pump shop at the store.

▸ **Corbin H. Myers** was named superintendent of industrial engineering at National Supply Company's Tor-

C. H. Myers

D. M. Sowle

rance, California plant. At the same time the company announced that **David M. Sowle** has been made superintendent of industrial relations, also at Torrance. Myers, a native of Ohio and a graduate of the University of Cincinnati, joined National Supply in 1947. Sowle attended the University of Wisconsin and the University of California. He joined National Supply's Torrance plant in 1946.

▸ **J. H. Satterwhite** has been elected president of the Westcott and Greis, Inc., division of American Meter Company, with headquarters in Tulsa, Oklahoma. A graduate of the Virginia Polytechnic Institute, Satterwhite spent 4 years with the Hope Natural Gas and Peoples Natural Gas Company of Pittsburgh, Pennsylvania. In 1915 he went to Cushing, Oklahoma as general superintendent of the Creek County Gas Company, and at the same time was superintendent of Yale Natural Gas. Satterwhite became associated with Westcott and Greis in 1917, which became a division of the American Meter Company in 1933.

J. H. Satterwhite

▸ **George W. Clinton,** a native of Hartshorne, Oklahoma, who graduated in June with a BS degree in petroleum engineering from the University of Tulsa, has been selected as a recipient of a fellowship given by Wellite Corporation. This fellowship amounts to $1500, including tuition, to do post-graduate work in petroleum production engineering at the University of Tulsa, according to J. P. Corbitt, president of Wellite.

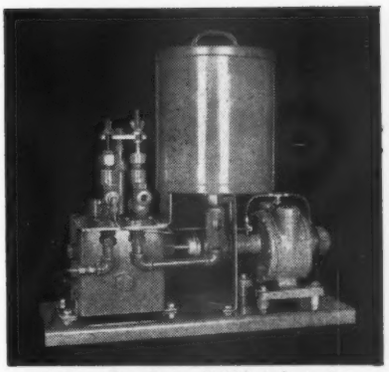
G. W. Clinton

Fast Expanding to meet your needs

...the *Manzel* Chemical Feeder Line

NEW Rotary Gas Drive Feeders

Efficient, dependable, Rotary Drive Motor operates on as low as 3 lbs. pressure.



Rotary Gas Drive Self-Lubricated

NEW Self-Lubrication

Automatic built-in system assures *complete* lubrication of Gas Motors, protects against corrosion and frequent stoppage. Available in either Rotary or Reciprocating Drive, and in kit for converting your present motor.

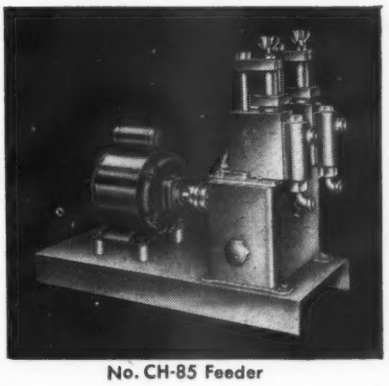
Reciprocating Gas Drive, Self-Lubricated

NEW Extra Large Series '85' Feeders

Adjustable to pump up to one gallon of liquid per minute per feed.

PLUS

Numerous other models, ranging in capacity from a few drops to 17.5 gallons per hour per feed.



No. CH-85 Feeder

Though Manzel Chemical Feeders are widely used and respected throughout the petroleum industry, we are working every day to add improvements, new features, and new models to the line. The new equipment described above is similar in principal to the other 'time-tested' Manzel Chemical Feeders, automatically injecting the chemical in exact proportion to the amount of liquid being pumped. Multiple units may be supplied with any number of feeds. Ask your Manzel Representative for details, or write...

Manzel

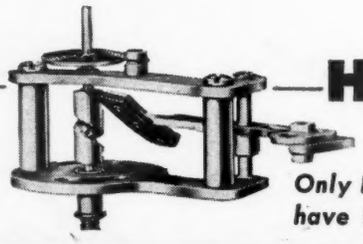
291 Babcock Street
Buffalo 10, N. Y.

The PLUS VALUES IN Helicoid Gages

This Vacuum Gage is an example of the extra value at no extra cost in all HELICOID GAGES.

Note:

1. Dial in inches of mercury vacuum, reading counter clockwise, to denote negative pressure and prevent confusion with a 30 lb. pressure gage.
2. Subdivisions in graduated steps of 0.2 inches for ease in reading scale.
3. Hairline Pointer adjuster to correct zero setting for changes in barometric pressure.
4. Guaranteed accuracy to within 0.15".
5. The new square flush case.
Another Helicoid *"first."*



HELICOID

ACCO

Only Helicoid Pressure Gages have the Helicoid Movement

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE COMPANY, INC.
Bridgeport 2, Connecticut

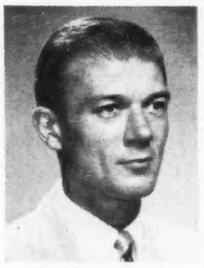
▸ **R. N. Storer,** a Lee C. Moore Corporation employee since 1942, has been appointed sales representative to

R. N. Storer

J. E. Harrell

cover the Illinois, Indiana, and Kentucky areas. Storer will have his headquarters in Centralia, Illinois. **J. E. Harrell** has been appointed sales representative by Lee C. Moore to cover parts of Texas, Oklahoma, and New Mexico. His headquarters will be in Midland, Texas. Harrell joined Lee C. Moore in 1922.

▸ **Edmund P. Lunken,** vice president of The Lunkenheimer Company, has also been elected secretary. He succeeds **Charles W. Burrage,** now manager of sales engineering, who resigned to devote full time to sales. A graduate of Yale University, Lunken has been associated with The Lunkenheimer Company since 1936.



E. P. Lunken

Charles W. Burrage, a graduate of Harvard University, has been with The Lunkenheimer Company since 1924. Prior to joining The Lunkenheimer Company, he served as an instructor at Massachusetts Institute of Technology, worked in the engineering department of Manning, Maxwell & Moore, Inc., and was chief engineer of the Nelson Valve Company.

▸ **Shelby Herron,** Houston, Texas has been appointed sales representative for Texas by the Kennedy Valve Manufacturing Company, Elmira, New York. Before joining Kennedy, Herron was in sales engineering work in the oil field supply business. He will handle sales for the Kennedy complete line of bronze and iron-body valves, waterworks valves and fire hydrants, malleable iron, bronze and cast iron fittings.

Shelby Herron

Classified

FOR SALE

9,500 feet electric conducting cable. New, never used, prestressed and preformed. 48,000 lbs. breaking strength. 2507 Mercantile Bank Bldg., Dallas, Texas.

FOR SALE

1 electric magnetic fishing tool outfit, with magnets capable of lifting 1,000 lbs. Adaptable for fishing junk like drilling cones and such out of oil wells. 2507 Mercantile Bank Bldg., Dallas, Texas.

ELECTRICAL ENGINEER

New large oil pipeline company requires electrical engineer to handle design construction and devise maintenance procedures all classes equipment to 5 KV switch gear. Some familiarity with sub-station to 110KV, 5000KVA desirable but not required. No communications or electronics involved. Include full professional and personal details and minimum salary first letter. Job is permanent. Write Box 119, c/o THE PETROLEUM ENGINEER, P. O. Box 1589, Dallas, Texas.

ENGINEERS

Major oil company operating in the Middle East requires graduate engineers in the following classifications:

SENIOR PROCESS ENGINEER
GEOPHYSICS ENGINEER
GEOLOGIST (SEISMOGRAPH)
ASST. GEOLOGIST (SUBSURFACE)
ASST. CHEMICAL ENGINEERS
ASST. CHEMIST (ANALYTICAL)
GEOLOGICAL DRAFTSMAN

Also we have positions for experienced and inexperienced civil, mechanical, electrical, construction and highway engineers.

If interested, write giving full outline of personal and employment history.

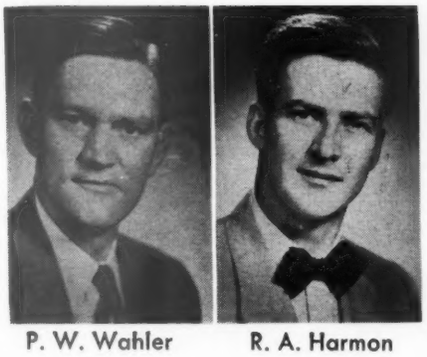
Write Box 117, Care THE PETROLEUM ENGINEER, P. O. Box 1589, Dallas, Texas

▸ **S. P. Tschappat,** president of Hercules Tool Company of Tulsa, Oklahoma has just announced the following additions to the company's field staff: **M. L. Creed** of Kilgore, Texas will represent the firm in East Texas, North Louisiana, Mississippi, and Arkansas. **F. R. (Tod) White** of Midland, Texas has been appointed field representative for West Texas, New Mexico, and Arizona. **Harold R. Jarvis** of Mount Carmel, Illinois will serve Hercules in Illinois, Indiana, Kentucky, and Michigan.

▸ **Alfred H. Drewes** has been named a director and member of the executive committee of National Lead Company. He is assistant to the president of the company and a director of Baker Castor Oil Company and of Titanium Metals Corporation of America. Since joining National Lead Company 15 years ago this month, Drewes has held various positions in the accounting, auditing, and administrative operations of the company.

A. H. Drewes

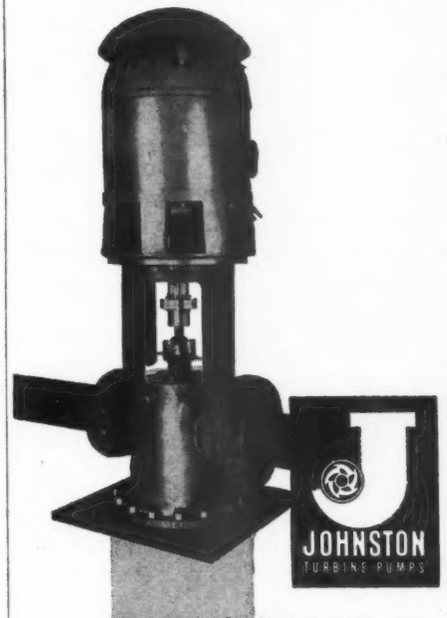
▸ **Paul W. Wahler** has been appointed service manager and **Robert A. Harmon** dealer sales supervisor for the Twin Disc Clutch Company, Racine, Wisconsin. Both men will make their headquarters in Racine. Wahler joined the engineering department of the company in 1937 as an engineering assistant. In 1940, he became a district service engineer stationed in Seattle, Washington. He became assistant district manager on the West Coast in 1946. Harmon has been connected with sales engineering since joining Twin Disc more than 3 years ago. He served as field representative and as eastern district sales engineer before promotion to his present duties of coordinating all dealer sales activities.



P. W. Wahler R. A. Harmon

No Other Pump Like It!

HEADS TO 1000 FEET!
TEMPERATURES TO 400° F.!
CAPACITIES TO 3000 G.P.M.!



Tough specifications to meet...sure, but the new Johnston Vertical Turbine Pump designed to handle volatile liquids and liquids near the boiling point does it without even breathing hard ... Proven performance in the refineries of several large oil companies is a matter of record.

This unit, which has the pump bowls enclosed in a sealed steel barrel, takes suction sufficiently above the pump bowls to give the required net positive suction head. The discharge can be at the same level as the suction or higher if necessary. Where there is a limited net positive suction head, such a unit offers many advantages:

1. **The supply vessel can be located wherever convenient and the pump bowls then set low enough for proper submergence.**
2. **Driver and piping connections are at the surface, eliminating dry sumps which are costly to build and expensive to maintain.**
3. **Nothing to lubricate but driver bearings.**
4. **Vertical design needs only ⅓ as much valuable floor space.**
5. **Due to diffuser type construction, this unit has higher efficiencies than conventional centrifugal pumps at high heads.**

Technical papers on the Johnston Volatile Liquid Pump are available. Send for as many copies as you need for interested personnel.

JOHNSTON PUMP COMPANY
2324 EAST 49TH STREET
LOS ANGELES 58, CALIFORNIA

A. R. Kelso has been elected vice president of Mack Trucks, Inc. At the same time he was named vice president and a director of Mack Manufacturing Corporation, the parent company's wholly-owned manufacturing subsidiary. In his new position he will be in charge of manufacturing and production at all Mack plants. Kelso joined Mack early this year as production counsellor.

A. R. Kelso

William S. Thomas has recently been appointed branch manager of the Houston, Texas office of the pump division, Byron Jackson Company, Houston, Texas. Prior to his appointment, he was branch manager for the San Francisco office of the company. Thomas is a graduate of the University of California at Berkeley and of the Harvard School of Business. He began with Byron Jackson Company in July, 1941, in cost accounting. In September 1944, he was made submersible motors production manager in Los Angeles and was appointed to the position of branch manager at the San Francisco office in 1946.

Mervin A. Fay has been named assistant general sales manager for General Refractories Company, Philadelphia, Pennsylvania. He has been assigned to the research department of the company since 1946, as ceramic engineer, having previously been associated with Bethlehem Steel Company in a similar capacity. He is a graduate of Pennsylvania State College in 1937.

W. F. Craig

Walter F. Craig, Jr. has joined the Climax Molybdenum Company as metallurgical engineer in the Chicago, Illinois office. He previously was supervisor, ferrous metals research at Armour Research Foundation.

Carlton R. Becker was recently appointed western factory representative for the Morse Chain Company, division of Borg-Warner Corporation, Ithaca, New York and Detroit, Michigan. He will supervise the sales of Morse mechanical power transmission products in the 11 states west of and including Montana, Wyoming, Colorado, and New Mexico.

Edward A. Livingstone, vice president in charge of sales of The Babcock and Wilcox Tube Company, has been named to the steel products industry advisory committee to advise in the administration of the Defense Production Act as it affects the iron and steel industry. The committee was established by the National Production Authority of the U. S. Department of Commerce.

Robert D. Scott has been appointed director of services of Wright Chemical Corporation, Chicago, Illinois. He will supervise the activities of the Wright service department and analytical laboratory. A graduate chemical engineer from Kansas State College, Scott has been associated in the water-conditioning field for many years.

Wayne E. Williams has been appointed western district manager for Tube Turns of Canada Limited. His office is at 110 Clark Building, Edmonton, Alberta. Williams was born in Los Angeles and majored in engineering at the University of Southern California. He has had 20 years of experience in the petroleum, chemical, and power fields, and formerly was associated with C. F. Braun and Company and the W. M. Barnes Company, Ltd.

ONE Pumping Unit Pumps TWO Wells

Pumping oil out of two wells at once from depths of 1250 feet is the job of this versatile Wisconsin Engine-powered unit, which slows to as few as 14 strokes a minute. The Wisconsin Heavy-Duty Air-Cooled Engine mounts a clutch-reduction assembly and operates on natural gas.

Builders of oil field equipment who know Wisconsin Engines "prove out" on *all jobs*, and users who see them "prove out" on *each job* specify and buy them because of features that assure maximum service with a minimum of servicing. Fool-proof any-climate air-cooling . . . tapered roller bearings at both ends of the crankshaft, taking up all thrusts . . . an OUTSIDE magneto with impulse coupling, for quick starting, summer and winter, are features that provide more trouble-free machine hours *gained on the job*, with less man-hours *lost in servicing*.

4-cycle single-cylinder, 2-cylinder, and V-type 4-cylinder models, 3 to 30 hp.

WISCONSIN MOTOR Corporation
MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 ATLAS BUILDING, TULSA, OKLAHOMA
M & M BUILDING, HOUSTON, TEXAS
505 SOUTH MAIN ST., WICHITA, KANSAS
OIL FIELD DISTRIBUTORS FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS.

ARMSTRONG BROS.
Better PIPE TOOLS

PIPE CUTTERS

"ARMSTRONG BROS." Three wheel and Standard wheel and roller Pipe Cutters are quality cutters throughout . . . built to give years of good service.

"ARMSTRONG BROS." drop forged Pipe Cutters are built for lifetime service with 1-piece drop forged steel heat treated body and a replaceable hardened steel nut to take up the wear and thrust of handle screw. Used either as 1-wheel (with 2 rollers) or 3-wheel (for close quarters).

"ARMSTRONG BROS." Knife Blade Cutter Wheels are machined from special alloy tool steel properly heat treated. They cut rapidly and easily, hold their keen edge.

Write for Catalog

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
5231 W. ARMSTRONG AVENUE • CHICAGO 30, ILL.

▸ **E. A. Studer** has been named chief engineer for The Empire Machinery Company, Ltd. He is a former staff member of the firm, whose headquarters are in Odessa, Texas. Studer, who has done plant and field work in the Permian Basin of West Texas and eastern New Mexico, will supervise all engineering work in connection with the shop and machinery sales. **W. K. "Kenny" Richey** has been transferred from Odessa to Abilene, Texas, where he will be district manager in charge of sales and service for Empire in that area.

▸ **Austin C. Ross,** manager of the Buffalo, New York works of Worthington Pump and Machinery Corporation, has been elected a vice president of that company at a recent meeting of the board of directors. Ross will continue to serve as Buffalo works manager. Ross joined Worthington in 1932 as assistant general purchasing agent, became assistant works manager of the Buffalo works in 1935 and works manager in 1940. He is a graduate of Toronto University.

A. C. Ross

▸ **William G. Moser** has been appointed general sales manager of the meter division of A. O. Smith Corporation. Moser has been selling SMITHway meters since 1938. **J. F. McDonald** has rejoined Smith and is now sales manager, midwestern area.

▸ **John Brennan,** Fluid Packed Pump Company Sales Engineer, left Los Nietos, California, early in October for a two-month trip to Venezuela. His headquarters will be at Maracaibo and will assist National Supply Company of Venezuela personnel in Eastern Venezuela. National Supply Company of Venezuela recently built a down-well pump service shop at Las Marchus, Venezuela.

John Brennan

▸ **H. F. "Foy" Schlittler,** has been appointed sales manager of Grant Oil Tool Company, according to a recent announcement, and will in future supervise general sales for Grant and MacClatchie Manufacturing Company. **Jerry Engstrand,** vice president of Grant Oil, was made assistant to the president, and put in charge of special and foreign sales and public relations.

▸ **R. H. McPeake** has been appointed sales manager of The Aldrich Pump Company, Allentown, Pennsylvania. A graduate of the U. S. Naval Academy, McPeake had 8 years' oil field experience with Standard Oil of New Jersey in both the Mid-Continent and Peruvian fields. In 1938, he left Standard Oil to join The Oil Well Supply Company, where he became export sales manager. In 1942, he joined the U. S. Navy and served for three years, after which he joined the firm in Buenos Aires.

R. H. McPeake

▸ **Horace Y. Bassett** has been elected to the board of directors of Calumet and Hecla Consolidated Copper Company to fill the vacancy resulting from the death of **Dudley S. Dean.** Bassett entered the employ of Wolverine Tube Company in 1939 as quality manager. He was elected a vice president of Calumet and Hecla in 1948.

Buel A. Devine has been named commodity sales manager of the Wolverine tube division of Calumet and Hecla. He will be in charge of tube sales to wholesalers and jobbers.

A. P. I. PIPE COUPLINGS

All Sizes and Types for Oil Field Use

LINE PIPE COUPLINGS A.P.I.
⅛" to 12"—Seamless and Special Processed—Black or Galvanized

PLAIN TUBING COUPLINGS A.P.I.
1" to 3"—Seamless

EXTERNAL UPSET TUBING COUPLINGS A.P.I.
¾" to 3½"—Seamless

CASING COUPLINGS A.P.I.
4½" to 13⅜"—Long or Short

HYDRAULIC COUPLINGS
⅛" to 3"—Seamless

REAMED AND DRIFTED A.I.S.I.
¾" to 12"—Seamless or Spl. Processed

DRIVE PIPE COUPLINGS
⅜" to 12"—Seamless or Spl. Processed

Consult Our Nearest Quick Service Sales Office:

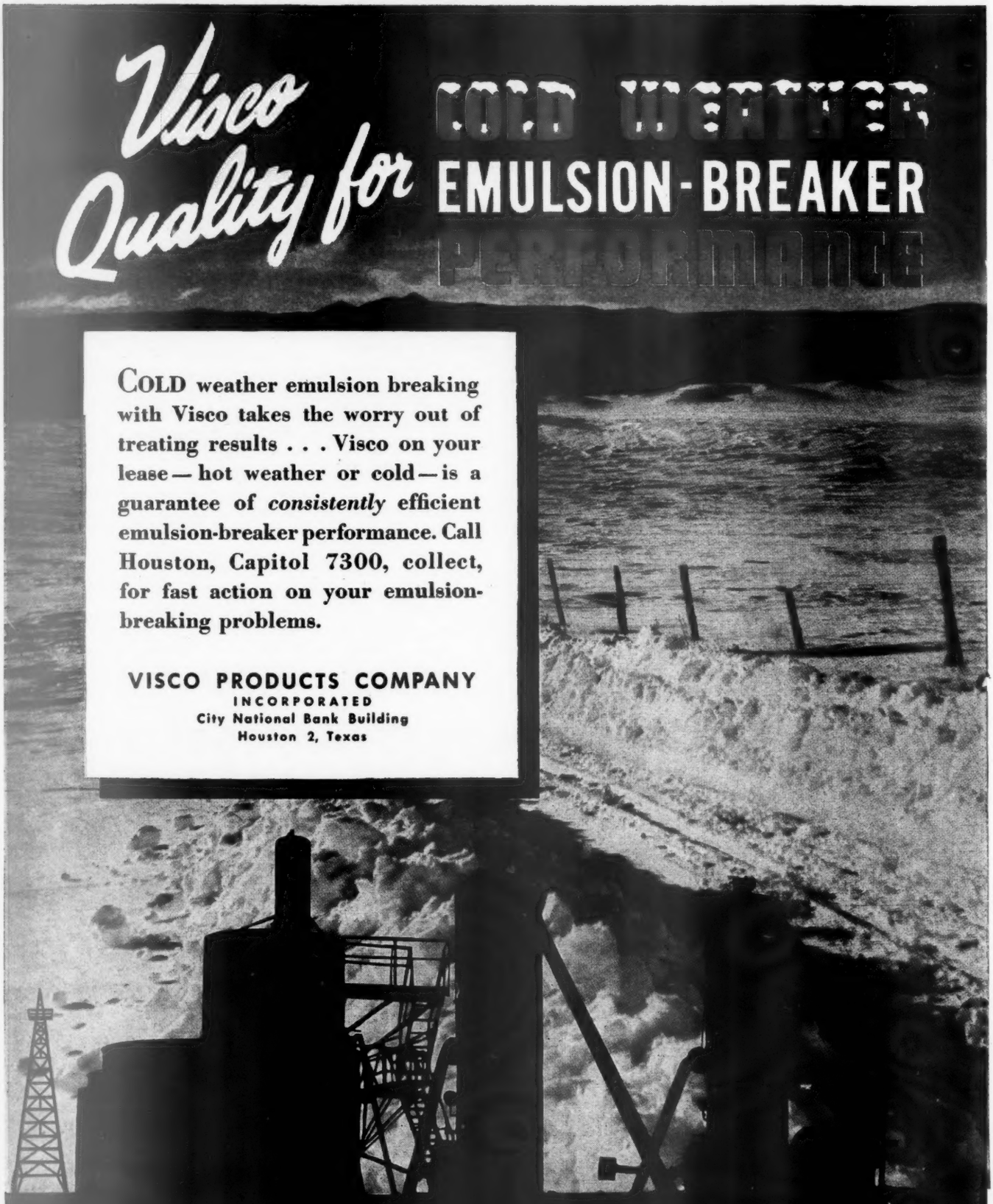
Albany, N. Y.—Albert L. Becker, 434 Clinton Ave.
Baltimore—Ted Barto, 2301 N. Charles St.
Boston—Wm. F. Bennett, 24 Spring St., Somerville
Buffalo—W. E. Spencer & Assoc's, 241 S. Elmwood Ave.
Chicago—Harry A. Jay, 122 So. Michigan Ave.
Denver—Earl H. Jones & Co., 1863 Wazee St.
Detroit—Thomas L. Osberger, 19451 Livernois Ave.
Erie, Pa.—R. J. Maggi, Box 711
Houston—Henry H. Paris Distributor, Inc., Bo 932
Kansas City, Mo.—Wm. J. Hebenstreit, 3122 Coleman Rd.
Los Angeles—James A. Riordan Co., 1400 Santa Fe Ave.
Minneapolis—Lin J. Krause, 200 Lumber Exchange
Newark, N.J.—Murray Eskin, Industrial Office Bldg.
New York—Henry Stein, 50 Cliff St.
Philadelphia—J. W. Worthington, 401 N. Broad St.
Portland, Ore.—Earl H. Jones & Co., 1233 NW 12th Ave.
Richmond, Va.—P. C. Abbott & Co., Mutual Bldg.
San Francisco—Earl H. Jones & Co., 1150 Folsom St.
Seattle—Earl H. Jones & Co., 619 Second Ave.

FACTORY 'PHONE: ELM GROVE 3296

WHEELING MACHINE PRODUCTS COMPANY

ELM GROVE STATION — WHEELING, W. VA.

Visco Quality for COLD WEATHER EMULSION-BREAKER PERFORMANCE



COLD weather emulsion breaking with Visco takes the worry out of treating results . . . Visco on your lease — hot weather or cold — is a guarantee of *consistently* efficient emulsion-breaker performance. Call Houston, Capitol 7300, collect, for fast action on your emulsion-breaking problems.

VISCO PRODUCTS COMPANY
INCORPORATED
City National Bank Building
Houston 2, Texas

Visco... CONSISTENTLY EFFICIENT DEHYDRATING AND DESALTING CHEMICALS

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating Compounds for use in the breaking and resolving of oil emulsions, or to grant licenses for such use, under the following United States Letters Patent: 2,050,639; 2,050,640; 2,206,589; 2,214,783; 2,214,784; 2,225,189; 2,303,414; 2,307,813; 2,318,034; 2,318,035; 2,321,056; 2,335,554; 2,454,808; 2,514,399. Visco Products Company is willing to grant licenses on a royalty basis, to oil companies, and to others desiring to practice the patented subject matter, under any and all of the above Letters Patent, permitting the user to purchase the oil treating compounds at will from any vendor, or to prepare the compounds for use or to use the compounds under the above Letters Patent. Application for license should be made to: **Visco Products Company,** Houston, Texas.

Machinery and Equipment

New! Improved! Needed!

(1) Portable Generator

A portable carbon dioxide generator, of the fuel-oil type, has been designed and built by the gas processes division of The Girdler Corporation, in conjunction with the Corps of Engineers, U. S. Army. It has a capacity of 300 lb of CO_2 per hour, and will operate efficiently in ambient temperatures ranging from minus 40 F to plus 130 F. The Girdler generator is mounted in an enclosed and insulated semi-trailer, 12½ ft high, 9 ft wide and 35 ft long. The gross weight of 43,000 lb is borne by 12.00 by 20 pneumatic tires, in dual arrangement.

(2) Gage Case

The Clapp Instrument Company, of Webster, Massachusetts, announces the new solid front Acragage. A solid

front type of gage case incorporating a solid cast web backing up the dial, with the entire back of the gage case covered by a waterproof blow-out disc with bonded Buna N seal. In the event of bourdon tube rupture due to overpressure, corrosion, or any other factor, the blow-out disc relieves the pressure in the case, acting positively at case pressures between ½ and 3 lb depending on the size of the case and the type of connection either bottom or back. The solid front restrains any such pressures within the case.

(3) New Pusher

A new pusher for use with the Allis-Chalmers HD-19 tractor has been announced by The Baker Manufacturing Company, Springfield, Illinois. Available as a complete unit or as an attachment, the new Baker pusher weighs approximately 725 lbs complete, is heavily reinforced, and designed to work with practically all types of scraper push plates.

(4) Gasoline Engine

A new 2 hp gasoline engine has just been announced by Power Products Corporation, Grafton, Wisconsin. The company claims the engine will weigh about 20 lb lighter than others of similar power. The new engine, a vertical twin cylinder type in lightweight aluminum, has been designated as Model 360 and has been designed primarily for use on rotary type power mowers of blade diameter sizes up to 21 in. It is, however, easily adaptable for other applications requiring vertical shaft drives.

(5) Valves

Valves for instrument piping and general use, which reduce threaded connections from 10 to 3 are now being made by Jerguson Gage and Valve Company, Somerville 45, Massachusetts. These valves, which combine unions, nipples, reducers, elbows, tees, valve, and drain valve into one unit, are offered in 9 styles, which include valves with or without union outlet as well as offset and jacketed valves. One valve can be used to replace the used valves and connections.

(6) Water Treatment

National Aluminate Corporation of Chicago, Illinois, has developed a water treatment program especially designed for "packaged" boiler installations. A service contract plan now fits the Nalco System to the needs of the packaged boiler user, whose actual chemical requirements are normally quite small, and provides the same protection and security found in many of the nation's largest power plants.

Get Full Details of December, 1950, Listing—Circle Figures and Mail Coupon to

THE PETROLEUM ENGINEER

P. O. Box 1589, Dallas, Texas

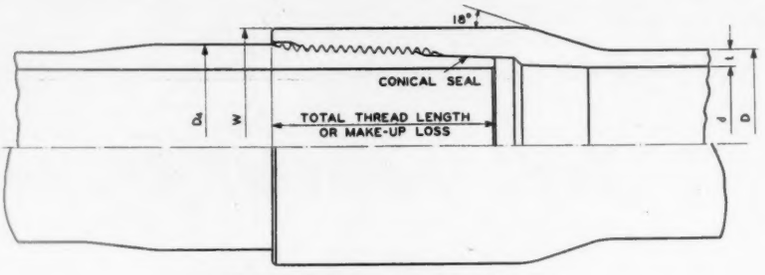
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34		
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50		
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66		

NAME ..... TITLE .....

COMPANY NAME .....

STREET ADDRESS .....

CITY ..... ZONE NO. ..... STATE .....



SPANGSEAL INTEGRAL JOINT TUBING
API-8 ROUND THREADS PER INCH
3/4" TAPER PER FOOT ON DIA.

TUBING DIMENSIONS

SIZE O.D. D	WEIGHT	WALL t	NOMINAL I.D. d	DRIFT DIAMETER	PIN O.D. D_p	MAKE-UP LOSS	BOX O.D. W
Inches	LBS./FT.	Inches	Inches	Inches	Inches	Inches	Inches
2.375	4.70	.190	1.995	1.901	2.594	2.911	2.969
2.875	6.50	.217	2.441	2.347	3.094	3.098	3.531

Drawing of Spang-Chalfant's oil well tubing connection.

Electric heating centrifuge.

(7) Tubing Joints

Spang-Chalfant Division of The National Supply Company, Pittsburgh, Pennsylvania, now has announced the availability of a new oil well tubing connection. Developed chiefly to resist joint leakage, the new product, known as Spangseal, consists of an integral joint equipped with the standard API thread in conjunction with a conical sealing surface. Couplings are thus eliminated. Spangseal tubing is highly leak resistant, the company claims. The leak resistant function of these sealing surfaces requires that close attention be given to these areas during all phases of manufacture. A precision machining job is required to attain the close and exacting physical relationship between the seals of both members of this new joint.

(8) Steam Trap

New, small forged steel steam traps have been developed by the V. D. Anderson Company, Cleveland, Ohio, for high pressure, super-heated steam service. These traps are suitable for steam pressures up to 500 lb with 800 F total temperature and have ½ or ¾ in. pipe connections. The head and body of these units are of forged steel to withstand shock and explosions. The internal parts are of stainless steel with valve and seat made of Anderloy, a special alloy developed by the V. D. Anderson Company for steam service. These traps have a recessed gasket to prevent blowing out.

(9) Reversible Tongs

J. H. Williams and Company of Buffalo, New York, has developed new "Vulcan" reversible tongs that will turn pipe in either direction without removing the tongs or loosening the chair. As removal of the tongs is unnecessary, no time is lost in reversing the action. Outer jaws can be removed to make an efficient fittings tongs for narrow beads and flanges. Jaw removal is accomplished by taking out the single standard bolt and nut used in assembly. These outer jaws are also reversible end for end providing double life. Williams reversible tongs are available in four sizes for pipe and fittings from ¼ to 8 in.

(10) Plug Valve

Kerotest Manufacturing Company, Pittsburgh, Pennsylvania, announces a new non-lubricated plug valve for operation in normal to sub-zero temperatures on all types of gaseous and volatile liquid service. Its tradename is Kerotest general twin seal valve. One of its advantages is that no lubrication is required, which eliminates daily maintenance. Supplied flanged end or screwed end comes in sizes from 2 to 8 in. for cold working pressures from 230 to 2000 psi. Sizes 2 to 4 in. are also available for cold working pressures of 3000 and 5000 psi. Dimensions conform to API and ASA standards.

(11) Low Pressure Alarm

A low pressure alarm designed to give positive warning when lube oil pressure fails has been developed, and is now being distributed, by Mid-Continent Supply Company at Fort Worth, Texas. The new whistle type alarm is made from sturdy cast bronze and stainless steel and will fit any make or type of engine. It gives a shrill positive warning when the lubricating oil pressure falls for any reason. Operation of the alarm is wholly automatic and installation is simple. It is easily attached to the engine block or any other convenient location and is put into operation by attaching the air line and the lube oil pressure line to the points marked on the unit.

(12) Electric Centrifuge

The W. L. Melton Company has manufactured a new electric heating centrifuge, which is being distributed exclusively by the L. K. Pump Valve Company, Houston, Texas. The centrifuge is claimed to heat samples in a pre-heating tube compartment, as well as in the thimbles attached to the two-way head of the centrifuge proper. It is thermostatically controlled. The company states that the oil sample will retain set temperatures during the rotating of the centrifuge, thus assuring true tests of high paraffin content or other high viscosity oils.

(13) Circuit Breakers

Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, has announced that its Types G-25 and G-50 low voltage air circuit breakers, previously available only as bare breakers or in metal-enclosed switchgear, can now be had for individual mounting. The individual, stationary mounted breaker has a sheet steel enclosure formed and welded into a housing that encloses the circuit breaker and cable connections. The front portion of the enclosure is provided with removable hinged panel, ventilating louvers, latching mechanism and door handle, hasp for locking, and necessary flash barriers.

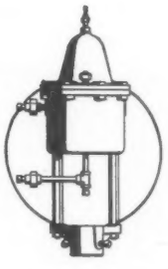
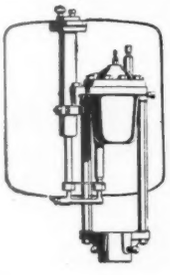
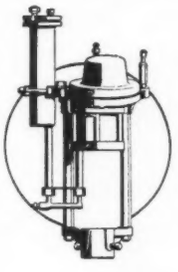
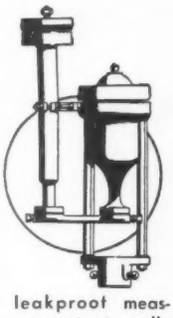
The rear portion or cable entrance box can be separated from the breaker housing and includes removable cover plates at the top, bottom and sides for easy connection, and cover plates with 3-, 3⅝-, 4⅛-, and 4⅝-in.

(14) Hard Catalysts

Filtrol Corporation, Los Angeles, California, has announced that it has developed a hard type regular Filtrol TCC catalyst and new very hard SR (sulfur resistant) pelleted catalyst. These catalysts are suitable for Houdriflow and Socony airlift units. These catalysts will be manufactured in large quanties by late Spring, 1951.

What's worth metering is worth metering right!

. . . and Foxboro offers the *right* meter for any metering problem. See the varied types below.

TYPES 1 & 2 Meter Body	TYPE 9 Meter Body	TYPE 17 Meter Body	TYPE 8 Meter Body	TYPE 6 Meter Body
				
light weight & low cost for indicators & portable recorders.	for differential ranges as low as 1" H_2O especially for low pressure gas and air service	Unequalled quality meter for general industrial service	longest float travel, greatest power, highest accuracy meter ever built	leakproof measurement at really *high* pressures without compromise in accuracy

a flow meter type for every need

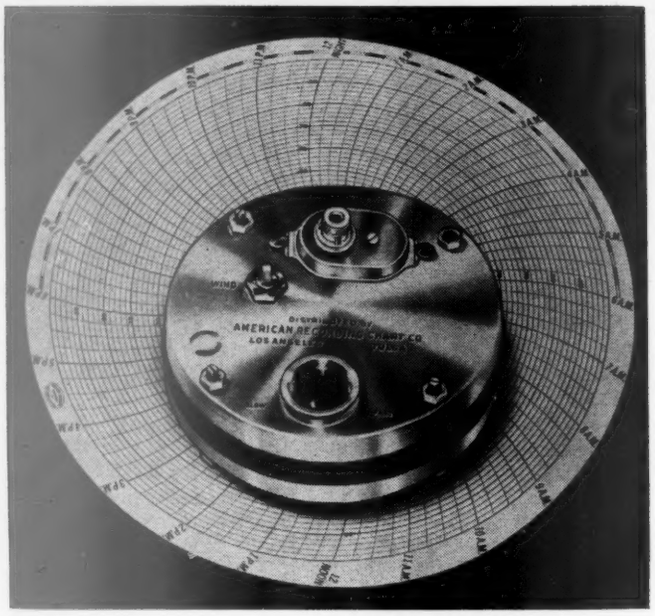
From its complete line of flow meters, Foxboro can offer the *best* type — in the proper range and static pressure rating — for virtually any metering problem. They are available as indicators, recorders, controllers, and transmitters . . . known throughout industry for their accuracy, dependability, and economy.

The widest selection of flow instruments is only one of many factors responsible for Foxboro's acknowledged leadership in flow metering. See how this factor—together with many superior, exclusive design features — give you the most value for your money in flow metering. Write for Bulletin 351-2. **The Foxboro Company, 130 Neponset Ave., Foxboro, Mass., U. S. A.**

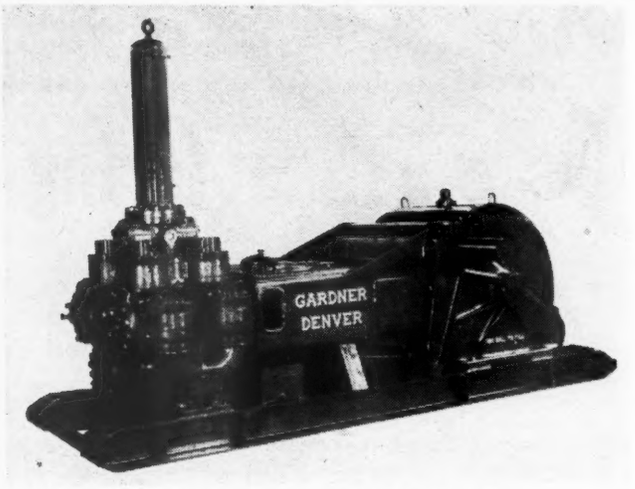
Specifications of Foxboro Meter Types Illustrated

TYPE	MATERIAL	MAX. W. P.	RANGES
2	Forged Steel	1000	100"–200"
9	Cast Iron	150	1" –10"
17	Forged Steel	1800	10"–400"
8	Forged Steel	1500	50"–400"
6	Forged Steel	3500	100"–200"

FOXBORO REG. U. S. PAT. OFF. **FLOW METERS**



American Recording's new chart and clock.



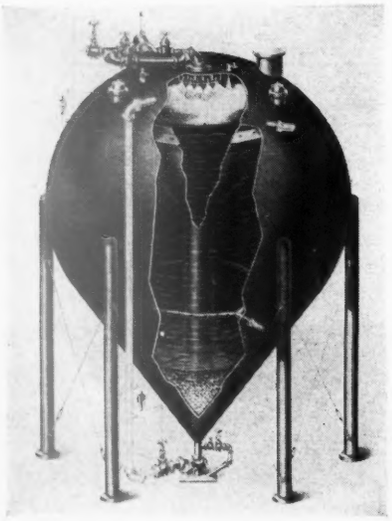
Power slush pump for deep hole drilling.

(15) 8-Day Clock

The American Recording Chart Company, Los Angeles, California, has developed a new chart and clock, which make possible continuous readings over a period of 8 days. This is possible with one winding of the clock. The clock is hermetically sealed and has been engineered to insure accurate operation under all field conditions, the company states. It is provided with 10 rotation speeds, the chart hub arbor turning once in 24 hr. Interchangeable converter gears effect one turn of the chart in 2, 3, 4, 6, 8, or 24 hr, or in 2, 3, or 7 days.

(16) Sedimentation Tank

Graver Water Conditioning Company, New York, New York, has developed a new type of sedimentation tank for hot process water softeners. Known as the Graver Sphericone, this new design is a hemisphere mounted on top of a cone. The inverted cone provides the uniformly increasing area from tip to circular top. The raw water, steam and chemical inlets, spray heater, deaerator, and treated water collector are all mounted in the hemisphere, while the inverted cone contains the downtake, sludge bed, and rising zone of the water being treated.



(17) Pumping Unit

The International Derrick and Equipment Company of Dallas, Texas announces its new F16-DA114 pumping unit. This unit has a polished rod load capacity of 15,900 lb, and a peak torque capacity of 114,000 in.-lb. It features the Ideco wheel type counterbalance crank, a rigid 4-legged samson post, a sturdy welded sub-base under the reducer, and clamp type pitman connections. The speed reducer is fitted with herringbone gears, and all shafts are carried on roller bearings. To assure a continuous supply of clean lubricant it is fitted with a magnetic type oil sump and labyrinth seals on all shaft extensions.

(18) Rein Jars

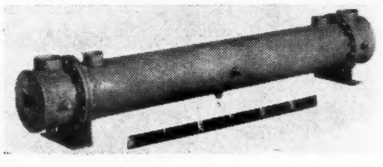
The Cavins Company, Long Beach, California, has developed new rein jars made of alloy steel, electric-welded, stress-relieved, and heat-treated. The rein sections are milled from solid bar stock, leaving the web an integral part of the parent metal, and the open end of the rein welded to the solid stock, after assembly, on which the joints are cut. The choice of material and its treatment, together with the inclusion of only two points of weld, make this jar capable of withstanding long and rough usage.

(19) Slush Pump

A new power slush pump, engineered especially for deep hole drilling, has been announced by Gardner-Denver Company, Chicago, Illinois. Known as the GXR, this new pump is a 7½ by 18 duplex power pump rated at 650 hp. It is said to incorporate the best features of Gardner-Denver FX type power pumps, plus many new features developed by Gardner-Denver engineers to meet the requirements of ever-deepening rotary oil well drilling. The GXR has a one-piece, dust-proof main frame cast of special Gar-Durloy alloy. The eccentric power end construction results in low bearing pressures, while double helical drive gears relieve main and jackshaft roller bearings of all thrust loads. The one-piece connecting rods have been designed to eliminate bolts that might loosen or fail under heavy plunger loads. Liquid cylinders are interchangeable.

(20) Heat Exchangers

Announcement was made recently by the Young Radiator Company of Racine, Wisconsin, and Mattoon, Illinois, that specially designed "A-800" shell and tube bundle heat exchangers have been developed for oil cooling in diesel locomotive, diesel engine, gasoline engine, and similar applications. The manufacturer states that "A-800" units are well suited for use with engine jacket water as the coolant, maintaining a balanced temperature between oil and water when required.



(21) Drilling Mast

A new International Derrick and Equipment Company portable drilling mast known as the "Full-View" has recently made its appearance.

Ideco Full-View masts are A-frame structures. It is held in the upright position by a pair of auxiliary legs, which serve also as a part of the raising mechanism (no guys are required). No braces or girts obstruct the driller's view of the traveling block or derrick man. The wide-spread legs permit the use of any type or size drilling rig and provide plenty of clear space around the catheads. The large drilling floor measures 24 ft from drawworks to pipe ramp and 27 ft 8 in. from side to side. The mast obtains its stability from the wide-spread placement of the 4 legs together with the latticed-box construction of the 2 main mast legs.

Raised by means of the traveling block, the Full-View mast is virtually pushed upward to drilling position by a pair of raising legs, pivoted at ground level. As the traveling block moves toward the crown, it pulls on raising lines, which are reeved as a block-and-tackle inside the bottom mast sections.

(22) Slush Pump Piston

A new type HD slush pump piston that permits the changing or original installation of rubbers without going through a tedious process of dissembly has been designed and manufactured by MacClatchie Manufacturing Company. A feature of the unit is that the main body of the piston never comes

in contact with liner surfaces so that it lasts almost indefinitely. All that is required to disassemble is to remove the piston rod nut and a follower, and end plates, center rings, and rubbers can be slid off the rod.

(23) Temperature Gage

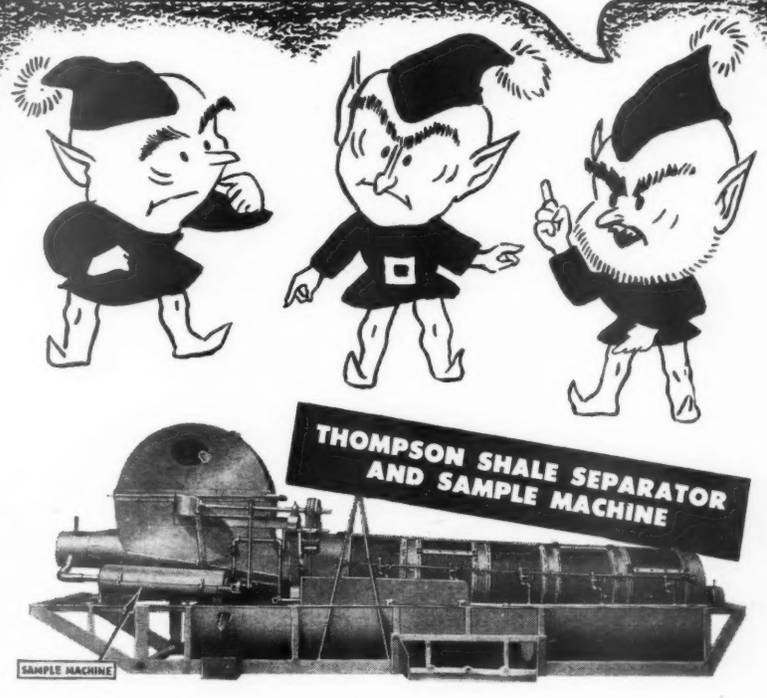
United States Gauge of Sellersville, Pennsylvania, has developed a new gage known as the Pneumatran for remote indication of temperature or pressure. It is especially recommended for use in oil refineries because a low pressure air line replaces the usual long high pressure line with its leakage and corrosion problems. Fire and explosion hazards are reduced by confining the inflammable or corrosive gases to their source. The Pneumatran is a weather-tight transmitter for indicating pressures with ranges from 15 to 60,000 psi.

(24) Self-Lubricating Spindle

One of the common but serious complaints against chemical process valves is the corrosion and binding of metal spindle threads. An outstanding feature of "Karbate" impervious graphite globe valves is the self-lubricating, corrosion resistant threads on the bonnet and spindle. Users without previous experience with impervious graphite valves are often skeptical of the ability of the spindle threads to stand up under continued use. "Karbate" valves are made by National Carbon Division, Union Carbide and Carbon Corporation, New York City.

"KILLER" SHALE SAYS:

AND STAY AWAY FROM ANY WELL WITH A THOMPSON SHALE SEPARATOR! YOU WON'T HAVE A CHANCE!



Shale and abrasives don't have a chance to chew up expensive drilling equipment when drilling mud is conditioned with a Thompson Shale Separator... *only clean mud* goes back into the well. If you are drilling deep, you'll want the Thompson "DWF," capable of handling maximum flow from the biggest mud pumps now in operation. Two other models available for shallow and medium depth wells. Attached SAMPLE MACHINE provides accurate foot-by-foot samples of cuttings.

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KEEPS DRILLING MUD CLEAN — PROVIDES *TRUE SAMPLES* OF CUTTINGS

(25) High Pressure Gasket

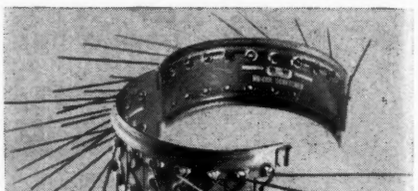
Flexitallic Gasket Company, Camden, New Jersey, reports that its new gasket (Style CGI) is a compression gage type with both an inside and outside ring. It has a spiral-wound construction with alternating V-crimped plies of metal and filler. In every pipe there is a certain amount of skin friction that sets up little eddies in the fluid passing through. At the joint, this friction is increased as the fluid pushes into the recess between flanges. With the new Flexitallic gasket, the steel ring practically fills the flange recess so that no turbulent barrier is set up. Flow is increased. The gasket is designed so that the inside ring can be conveniently remounted in new replacement gaskets.

(26) Water Purifier

Paddock Engineering Company of Dallas, Texas, has developed a new low-cost water purification and storage system called Tri-Sure. The new system is a "complete packaged water system" that features Sureclor, a new-design water-energized chlorinator, along with pumping, filtering, and pressure-storage equipment. Systems are portable and easily moved.

(27) Scratcher

B and W Incorporated of Houston, Texas, and Long Beach, California announces the Nu-Coil scratcher for cementing oil well casing. The scratcher



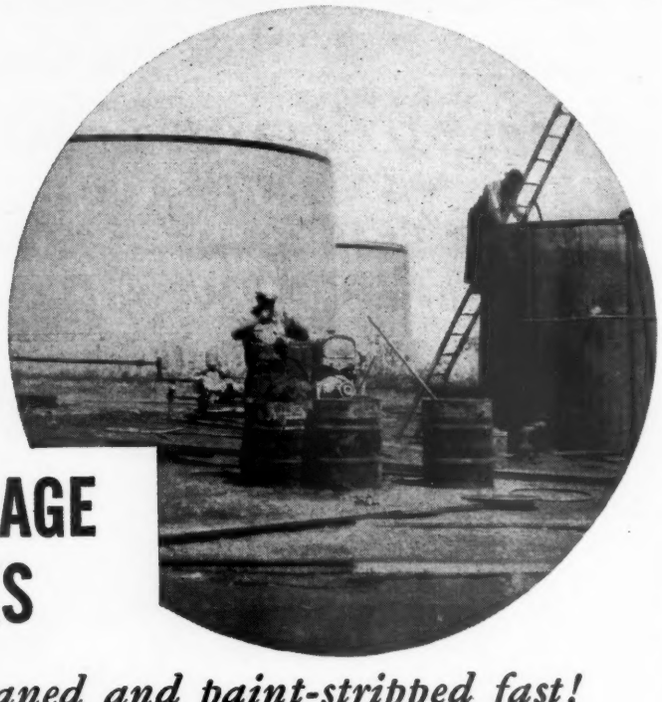
is of the coil spring reversible type. A heavy ribbed perforated sleeve is used and the raised shoulders increase the strength of the sleeve and are protection for the coil spring wire units, which are mounted on the outside of the sleeve between the upper and lower raised shoulders. Each coil spring unit is double ended. The steel wire units are 5 in. long and project outwardly at an angle. The scratcher operates when casing is run into the well, also during circulation period and when cement slurry is pumped into the well.

(28) Torque Indicator

Now in manufacture by Hunt Tool Company, Houston, Texas is a torque indicator for power rigs, designed for simplicity, ruggedness, and accuracy. The indicator consists of a hinged sprocket assembly, diaphragm, hydraulic gage, and hand pump. The indicator sprocket is positioned so the rotary chain rides on it, and any change in torque is reflected by more or less pressure on the sprocket assembly against the diaphragm which passes the change along to the gage. The indicator assembly may be used on any type power rig and chain guards, with or without oil bath.

(29) Pipe Line Wrap

A new product, Fiberglas pipe line outer wrap, has been announced by Owens-Corning Fiberglas Corporation, Toledo, Ohio. A corrosion-protective material, Fiberglas wrap is designed to act as an exterior protection for underground pipe lines. It is composed of asphaltic compounds with or without tar components reinforced in all directions by a glass fiber mat and longitudinally by strong Fiberglas yarns. Some of its characteristics, according to the company, are: Protection for enamel coating, prevents damage during lowering-in, safeguards against backfill, equalizes coating thickness around pipe, lessens soil stresses on enamels.



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PETROLEUM SERVICE DIVISION

(40) Industrial Hose

Aeroquip Corporation of Jackson, Michigan has announced publication of Bulletin No. 113, which contains information in the way of industrial hose and fittings specifications as well as instructions on assembling fittings to hose lines. By using Aeroquip flexible hose and detachable fittings, hose lines can be hand-assembled on the spot, using bulk hose and the particular fittings needed. Fittings may be saved and used many times. Self-sealing couplings were designed to facilitate service and maintenance of equipment requiring the use of liquid-carrying lines. The "Breakaway" coupling was developed to eliminate the breaking of hose lines, and the loss of hydraulic fluid.

(41) Porous Media

The Carborundum Company of Berth Amboy, New Jersey, has issued a new 56-page engineering bulletin on porous media. The bulletin covers all filtration and diffusion applications for ceramically bonded media. Numerous charts, tables, and illustrations supplement the technical information that deals with uses, design, installation, operation, etc.

(42) Sheet Packings

A new, profusely illustrated, 20 page catalog just issued by Green, Tweed and Company, North Wales, Pennsylvania brings together all material on the Palmetto packings previously made available in separate product bulletin sheets, and includes data on such new items as the recently introduced Palmetto pisto-ring packing for liquid pistons on inside-packed piston pumps. Palmetto self-lubricating, molded and sheet packings—both standard and special—are covered in detailed text that points up application, structure, and performance for each individual packing. In addition, the manufacturer has devoted a section to a full explanation of self-lubricating packings manufacture and performance.

(43) Two-Way Radios

A new booklet, covering the use of two-way radio in the petroleum industry, is now available from the General Electric Commercial Equipment Division at Electronics Park, Syracuse, New York. Based on present radio operations in the industry, the booklet covers general uses being made of two-way equipment, types of systems, licensing regulations, equipment capabilities, special installations, relaying, costs of installations, and savings experienced by operators using two-way radio in their work.

(44) Combination Shovel

The Lodover, a new 1-yd combination overhead and front-end shovel for International Harvester tractors, is fully described in a new 8-page illustrated catalog just published by Service Supply Corporation, Philadelphia, Pennsylvania.

According to the catalog, the Lodover substantially increases loading production, because turns are eliminated. On many jobs, Lodover overhead loading steps up output as much as 50 per cent. Elimination of turns, as many as 1900 per 8-hour shift, also substantially lengthens tractor life.

(45) Motor Starters

Allis-Chalmers motor starters — Type H— for 2300 to 5000-volt squirrel cage, wound rotor, synchronous and multispeed motors are described in a new 12-page bulletin released by the company. The starters are built for full voltage or reduced voltage, reversing or non-reversing, with plugging, dynamic braking, and multispeed features. Ratings are up to 2500 hp at 5000 volts. The contractors (air break or oil immersed), protective devices, meters, and relays are engineered and put in a steel cabinet.

(46) Grease & Oil Compounding

Manufacturing techniques and production facilities of the 74-year old grease and oil compounding firm of Brooks Oil Company are arranged in the form of a picture tour in "The Brooks Oil Story" the title of a 20-page booklet published by that company. Included in the booklet are details on a variety of Brooks Leadolene Klingfast products, plus information on the planning procedure, research facilities and plant equipment.

(47) Pump Drives

Descriptions or right angle geared pump drives and their application to vertical turbine pumps is the subject on a new 8-page bulletin issued by Peerless pump division, Food Machinery and Chemical Corporation on the Peerless Gearturbo pump head. Right angle gear drive applied to vertical rotative shaft pumps is most suitable for applications where electricity is not available, where natural gas, gasoline, diesel, or steam power is more economical or where the added security of standby power is desired in case of electrical power failure. Gearturbo heads are offered in 9 sizes, with speed increasing ratios of 1 to 1, 1 to 2, 2 to 3, 3 to 4, and 4 to 7 and with one speed decreasing ratio of 11 to 10 and in horsepower ratings from 3 to 300 hp.

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Petroleum Production Engineering, *by Lester Charles Uren, volume 3. McGraw-Hill Book Company, 330 West 42nd Street, New York 18, New York. Pages, 639. Price, $7.50.*

The third volume supplements the two earlier texts dealing with technologic material. Presented from the point of view of the practical engineer, separate chapters provide a varied and comprehensive panel of topics, such as the economic geography of petroleum, oil and gas land acquisition and control, labor management, oil-industry taxation, cost accounting for oil production, and oil and gas conservation. Other chapters review the methods of oil and gas property appraisal and analysis of typical petroleum engineering problems.

Elements of Oil Reservoir Engineering, *by Sylvain J. Pirson. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, New York. Pages, 427. Price, $6.50.*

This book develops and coordinates the principles governing the behavior of geological petroleum reservoirs placed under protection of external sources of energy. The discussion develops the concepts of three production processes—water, segregation, and depletion drives, operating singly or in combination.

The author introduces the concept of the driving index, which allows a constant check on production efficiency. Other topics as the application of fundamental equations, the fractional rate of frontal advance formulas, and the material balance equation are studied. The author is special research associate for Stanolind Oil and Gas Company.

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The Prevention of Deterioration Abstracts, *National Research Council, 2101 Constitution Avenue, Washington 26, D. C. Pages, 2000. Price, $50.*

At the request of the Armed Forces, the National Research Council is again offering *The Prevention of Deterioration Abstracts* on a subscription basis. Abstracts are classified under the headings: Biological agents; electrical and electronic equipment; fungicides and other toxic compounds; lacquers, paints, and varnishes; leather; lubricants; metals; miscellaneous; optical instruments and photographic equipment; packaging and storage; plastics, resins, rubbers, and waxes; textiles and cordage, and wood and paper. The yearly rate includes two binders and index tabs. Subject and author indexes are compiled annually to cover abstracts issued from July through June.

Subsurface Geologic Methods, *second edition, edited by L. W. LeRoy, Colorado School of Mines Department of Publications, Golden, Colorado. Pages, 1156. Price, $7.*

Owing to the depletion of the supply of the first edition of *Subsurface Geologic Methods* it was deemed necessary to revise and enlarge the book as a second edition.

The second edition includes several new sections of concern to the subsurface geologist. Secondary-recovery methods, evaluation of petroleum properties, geochemical methods, micrologging, drill-stem testing, mud chemistry, and acidization are a few of the topics. At the end of each chapter a series of questions have been added to permit instruction in university work. Also in this volume has been added an index.

The Friction and Lubrication of Solids, *by F. P. Bowden and D. Tabor, published by Oxford University Press, 114 Fifth Avenue, New York 11, New York. Pages, 337. Price, $7.*

This book describes an experimental study of the physical and chemical processes that occur during the sliding of solids, particularly of metals, and an investigation into the mechanism of friction and boundary lubrication. It also deals with a number of the physical properties of solid surfaces. The work was begun in Cambridge a few years before the war and was continued in the Tribophysics Division of the Australian Council for Scientific and Industrial Research. Some aspects of the work is still in progress in Melbourne.

The Properties of Asphaltic Bitumen, *edited by J. Ph. Pfeiffer, Elsevier Publishing Company, Inc., 250 Fifth Avenue, New York 1, New York. Pages, 285. Price, $6.*

This volume is not an encyclopaedic work, but it is in intended to acquaint the reader with modern views regarding the structure of bitumen as a colloidal system and the explanation they offer of its physical and chemical properties. The book deals with asphaltic bitumens and asphalts—high molecular products that are obtained from mineral oil. It also indicates how this knowledge can be employed in determining the most suitable types of bitumen to be used in the various technical applications.

Modern Refractory Practice *(third edition), Harbison-Walker Refractories Company, Farmers Bank Building, Pittsburgh 22, Pennsylvania. Pages, 440. Price, $6.*

This work on industrial refractories and applications combines practical engineering, a comprehensive coverage of technical methods, and a catalog of Harbison-Walker products. It contains scale drawings of 20 types of furnaces, illustrating up-to-date industrial practice. It also contains a chapter devoted to suggestions of a practical nature regarding the selection, care, and use of refractories, including handling, installation, and service factors that affect the life of refractories.

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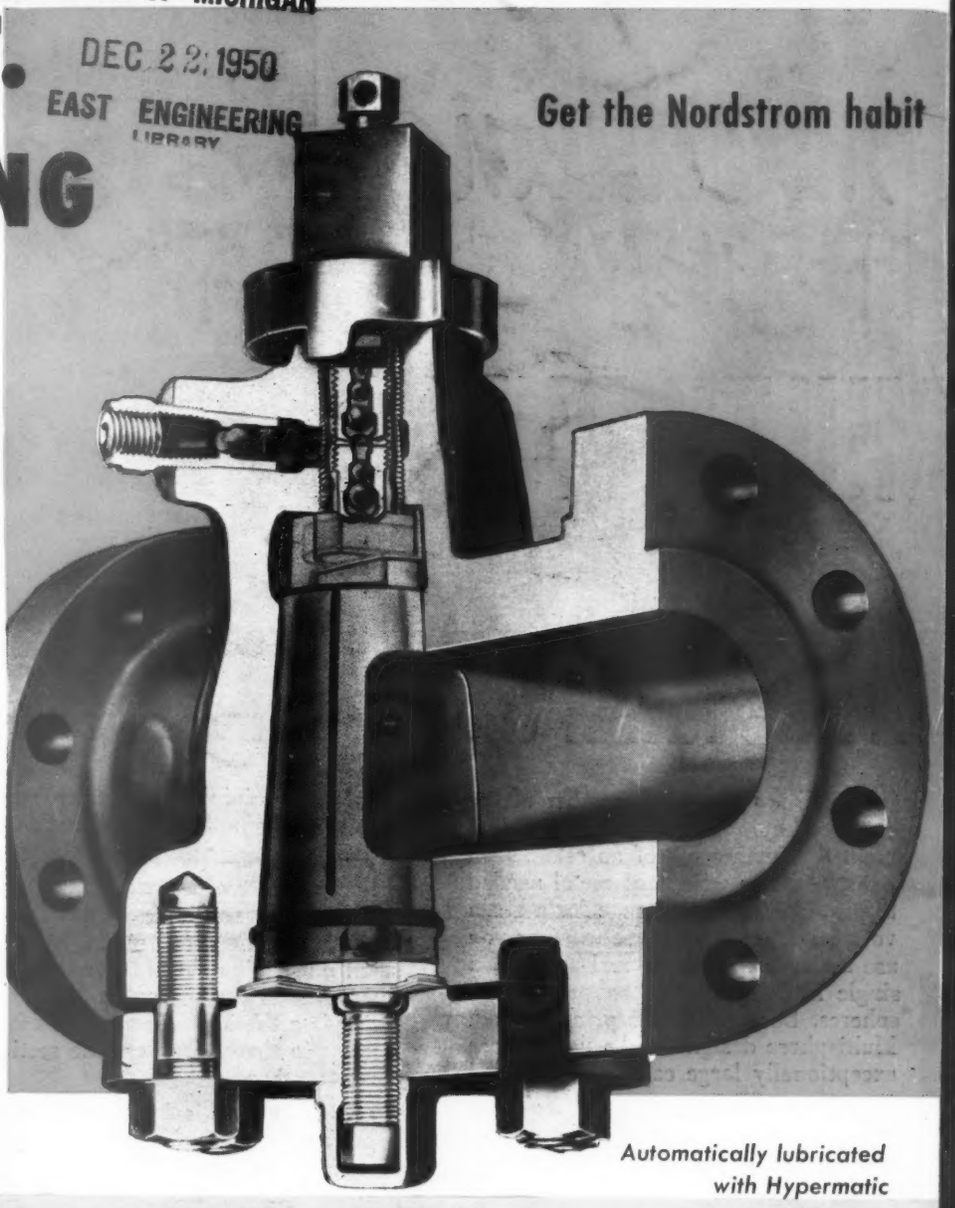

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ble of Contents Page 3 • Advertisers' Index Page 6

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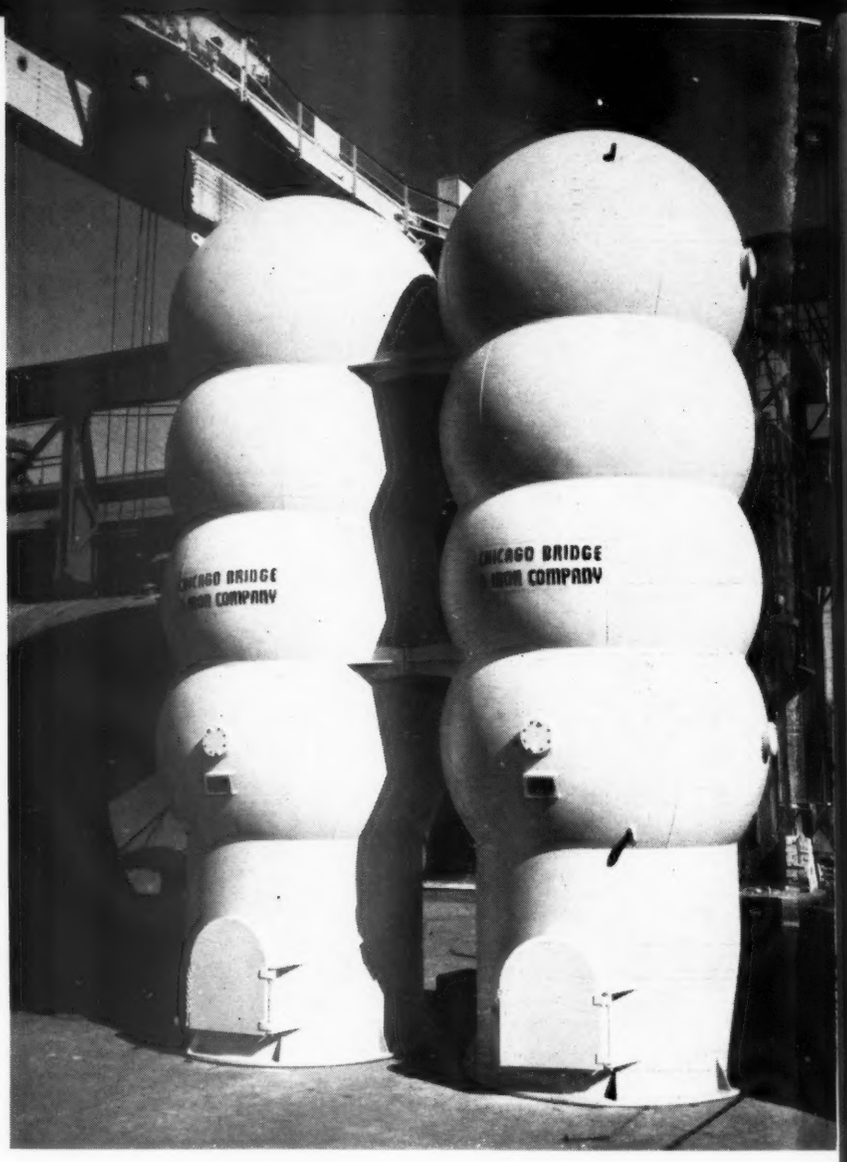

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